(Established 1832).

AMERICAN ENGINEER AND RAILROAD JOURNAL.

PUBLISHED MONTHLY

BY

R. M. VAN ARSDALE

140 NASSAU STREET, NEW YORK

J. S. BONSALL, Business Manager.
F. H. THOMPSON, Eastern Representative

R. V. WRIGHT, } Editors.
E. A. AVERILL, }

NOVEMBER, 1909

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matter in detail it was decided that it would be possible to reduce this cost 30 per cent. The various departments of the plant were given estimates as to their percentage of the total amount with the result that in a very short time a reduction of 21 per cent. had been made and it is expected that when business picks up it will not only be possible to make a 30 per cent. reduction, but go beyond it. This without in any way affecting the efficiency of the plant and with practically no increased expense for supervision.

* * * * * * *

The following is taken from Harrington Emerson's book on "Efficiency": "When each unit of locomotive repair is standardized, the sum of the units shows a cost between $0.03 and $0.06 a mile for maintenance. The actual average costs on the railroads are between $0.06 and $0.12—therefore twice what they ought to be. The standardized cost of maintaining freight cars is as low as $30 per annum. Actual average costs run from $45 on some roads to over $100 on others. Standards of maintenance of way vary, but innumerable assays of actual work show a maintenance-of-way labor efficiency of scarcely more than 30 per cent."

* * * * * * *

On a certain railroad a study of the cost of oil for freight car journal boxes indicated that it was entirely too high; at the same time there were too many hot boxes. Regulations were made for a more careful inspection and it was ordered that the boxes should be re-packed at regular intervals. To do this each division point was required to do a certain amount of this work each month. Each one of these points was also given a *reasonable* allowance of oil for doing the work. As a result the expenditure for oil was greatly decreased, and there was a remarkable reduction in the number of hot boxes. All of this was obtained by placing the oil on an allowance basis and issuing proper instructions, which it was plainly understood must be lived up to.

UNIT SYSTEM OF ORGANIZATION ON THE HARRIMAN LINES.

The new system of organization being installed in the operating department of the Harriman Lines is a unit system. It is predicated upon the belief that true organization demands the preservation of the integrity of units; that overlapping jurisdictions must be avoided. For example, it denies the right of the chief engineer to have direct written communication with the division engineer or road master; or for the superintendent of motive power to deal in writing with any office but that of the division superintendent. A division is made a complete unit and duplication is avoided by a consolidation of all the files at the division headquarters. This in turn permits giving all the members of the division staff the uniform title and authority of "assistant superintendent." The result is to increase the supervision of the working forces and to augment the efficiency of service units. So tenuous is the line between the various so-called departments that this system pools the energies of the staff. It is left to the head of each unit, in case of the division, the superintendent, to co-ordinate the technical specialties of his staff for the best interest of the service.

Practical experience has shown already that this elasticity is far better than an attempt to define authority by rigid rules. Each assistant is held responsible for a particular branch of the work, such as track, equipment, train service, stores, etc. He is aided in the work of supervision by his fellow assistants of the staff. It has been found that the superintendent can be trusted to maintain a proper balance among his assistants, all of whom have been sufficiently long in the service to have a common-sense idea of propriety in any occasion that may arise. The system, like the English Constitution, is based on unwritten laws. It has a practical flexibility superior to standard charts of organization.

The underlying theory is that the service can only be improved by the broadening of the individual. Under the system each official transacts business in his own name and no person is allowed to sign the name or initials of another. Instead of ten or twenty dispatchers and clerks signing the name of the superintendent, each official or dispatcher signs for himself, the presumption being that in so doing he is properly delegated by the superintendent to the specific purpose in hand. The superintendent's name and initials cease to be cheap. The idea is to inculcate and locate responsibility and to give a communication weight in accordance with the actual signer rather than in accordance with the fancied importance of the sending office.

An essential feature of the system is a senior assistant for each unit who takes charge of the office and is relieved from traveling duties. Although the system reduces the volume of correspondence from 30 to 50 per cent., it is felt that the office end is of sufficient importance to hold the undivided attention of the second best official on the division or other unit. The superintendent, for example, and all the other assistants go out on the road, but the senior assistant remains at headquarters and preserves the continuity of the division activities. All communications received and sent are supposed to pass over the desk of this senior assistant, both for his information and for purposes of co-ordination. This scrutiny frequently results in cutting out useless correspondence. It should be borne in mind that much of this correspondence is already signed by some other assistant before reaching the senior assistant. In case, however, any assistant is out on the road, say the former division engineer, or one time master mechanic, the communication is not signed by a clerk for the absent official, but by the senior assistant himself in his own name, thus preserving individuality. The principle to guide subordinate officials and employees is the same as in train dispatching, to be governed by the latest instructions received.

Not only does this system facilitate administration, reduce correspondence and increase supervision, but it broadens the individual for future advancement. The division engineer must take some interest in motive power, the master mechanic cannot ignore track. As a consequence such division engineer or master mechanic has open to him an avenue of competition for the coveted position of superintendent and all possibilities beyond.

This system is now in successful operation on seventeen units of the Harriman Lines. It is estimated that its extension to the remaining units of the operating department will result in saving the writing of probably *300,000* unnecessary letters per year. It is explained that the cost of producing these unnecessary letters is a mere trifle in comparison with the magnitude of the operations involved. It is their retarding effect upon administration that is undesirable. They delay the game.

* * * * * * *

The above organization, also known as "The Hine System of Organization," is being installed under the direction of Major Charles Hine, special representative on the staff of the director of maintenance and operation. He is a graduate of West Point Military Academy and studied law and was admitted to the bar while serving as a lieutenant in the army. After resigning his commission in 1895 he entered the service of the Big-4 as a brakeman and served in various positions, finally becoming general superintendent. In addition to this railroad experience he has been connected with several railways and corporations on special work and has made reports on different features of a number of railroads. During the Spanish-American war he served as a major of volunteers and was engaged in the siege of Santiago de Cuba. On returning from the war he was for a time inspector of safety appliances for the Interstate Commerce Commission. In 1907 he assisted in the revision of the business methods of the Department of the Interior at Washington and acted as a receiver of the Washington, Arlington & Falls Church Electric Railway. Many of our readers will recognize him as the author of "Letters from an Old Railway Official to His Son."

CHAIN GRATES.

A study of chain grates in power plants was recently made by the United States Geological Survey. The following summary is taken from bulletin 373 containing the report of this investigation:

The chain-grate stoker was found in plants carrying uniform loads and in plants where loads were extremely variable. With a uniform load and a proper setting there should never be any smoke with this equipment, but when a variable load is carried a faulty method of operation may cause the emission of dense smoke. In a chain-grate plant having a variable load, with the fire carried up to the water back, a sudden release of load will require a reduction of draft. Too often the damper is nearly closed, so that the coal on the grate and the fresh coal fed to hold the fire are burned with a limited air supply, causing the stack to smoke badly.

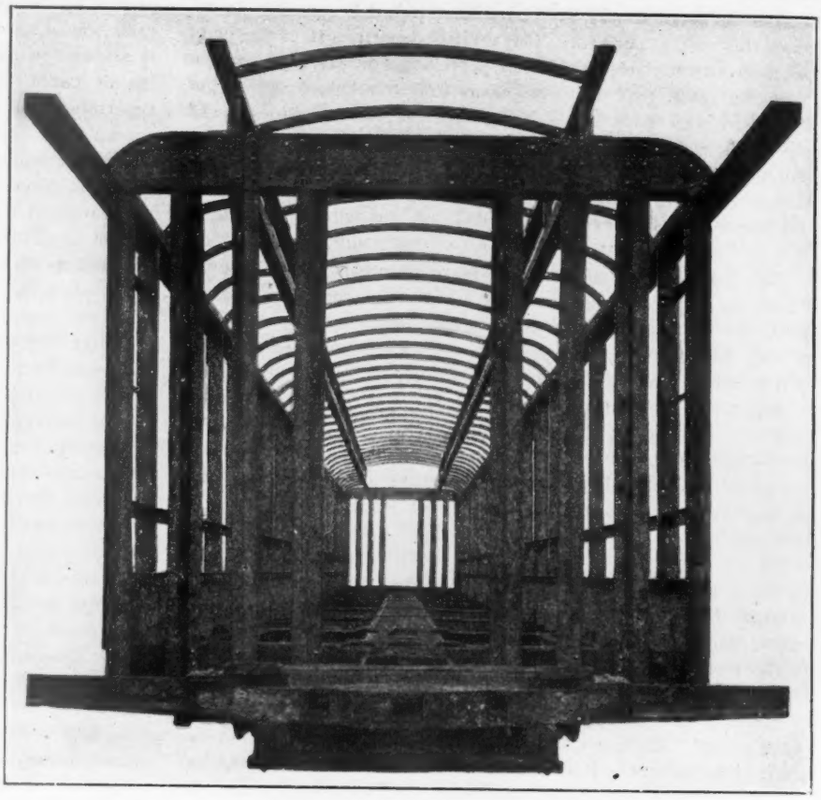
Plants equipped with the chain grate can be made to carry a very variable load with good results by changing the thickness of the fire, the speed of the grate, and the position of the damper to suit the load. The draft should not be reduced below a certain value, which can be determined for each plant by gradually closing the damper and watching the stack. In a plant where the maximum variations of load are nearly the same, it might be necessary to vary only the speed of the grate and the position of the damper. The damper regulator is often the cause of a smoky stack, because it is usually set to choke off the entire draft, a condition which is never necessary.

Both the speed of a chain grate and the slope of the ignition arch are important. Too often the grate is run so fast that volatile matter is being driven from the coal as far back as the center of the grate; usually in this case there is not only a loss from incomplete combustion of the gases, but also losses from unconsumed carbon in the ash and from injury to the grate. Live coals in the ashpit will not only warp a grate, but gradually burn it up. The grate should not be run so fast that it will be hot when re-entering the furnace. In one plant where a high draft was carried, a sloping arch was removed, and an arch built parallel to the grate. With the sloping arch the stack smoked, but with the flat arch it was entirely clean.

With chain-grate equipment a plant may run very inefficiently if the fire is carried only on the front half of the grate, as sometimes happens. When coal is burned in this way with a proper setting, it is because the fireman finds it the easiest way to carry a variable load and have a clean stack, demanding less of his attention in operation.

At some plants the boiler is forced by firing considerable coal through the inspection door. Although the desired result is accomplished by this practice, the plant becomes the equivalent of a handfired plant and the stack will invariably smoke badly.

The Erie reports 125,000,000 passengers carried in the past 5 years without a fatality.



STEEL FRAME, BUFFET LIBRARY CAR.

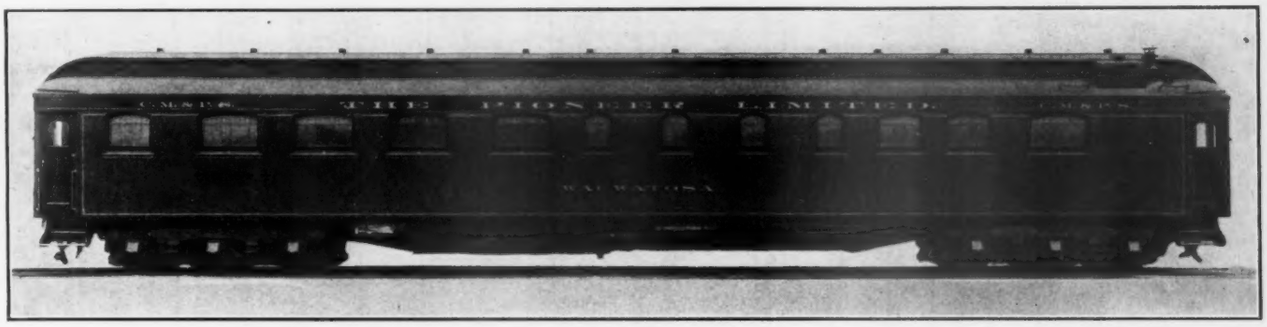
INTERIOR OF STEEL FRAME, BUFFET LIBRARY CAR.

BUFFET LIBRARY CARS.

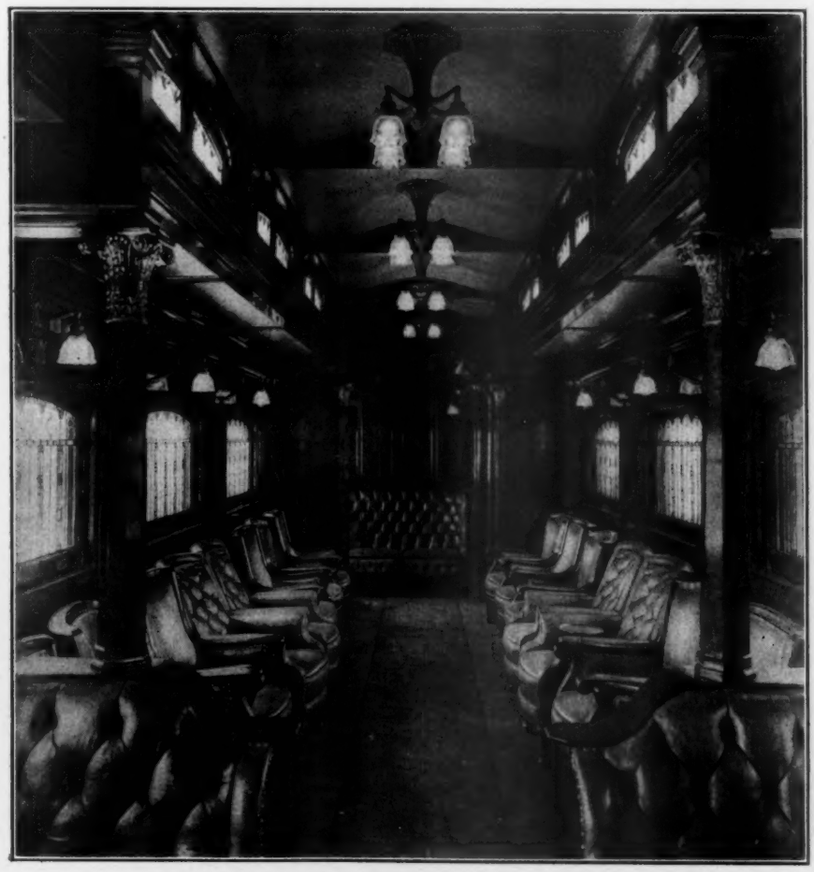
CHICAGO, MILWAUKEE AND ST. PAUL RAILWAY.

The Barney & Smith Car Company recently delivered to the Chicago, Milwaukee & St. Paul Railway some handsome passenger cars which embody a number of interesting features. This equipment consists of ten baggage, mail and express cars, fifteen day coaches and two buffet library cars.

An examination of these cars makes it apparent that the new Pacific Coast extension of the St. Paul is to be supplied with the very best possible accommodations for its passenger traffic. All of these cars are modern in every particular and the interior design and decorations are strikingly fine and original. In the structural features the three classes of cars are substantially the same, so that the description of the buffet library car will give a good general idea of all of them.



BUFFET LIBRARY CAR FOR THE "PIONEER LIMITED"—CHICAGO, MILWAUKEE & ST. PAUL RAILWAY.



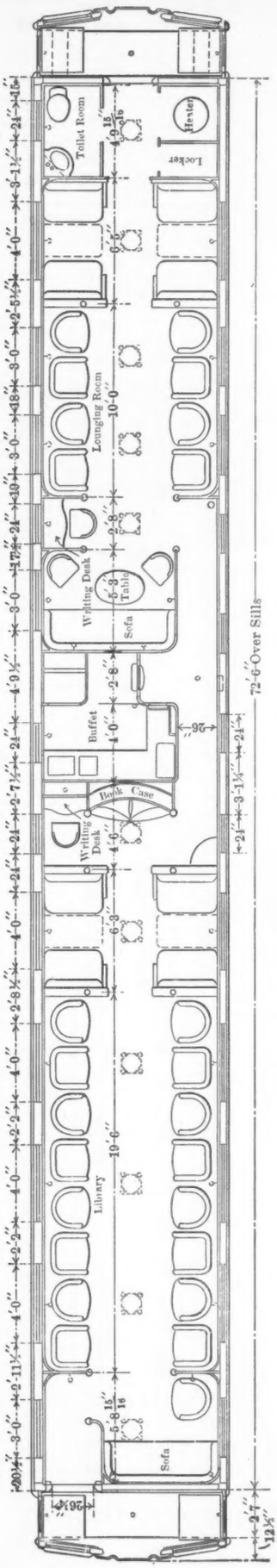
LIBRARY END OF CAR SHOWING SOFA.

These cars are 72 ft. 6 in. long over end sills, 10 ft. wide over the frame and are constructed with complete self-supporting steel underframes and a steel framework for the superstructure. The underframes are composed of built-up girder center sills and built-up side trusses in connection with the Commonwealth Steel Company's combined cast steel double body bolsters and platforms. The center construction consists of two 5/16-in. web plates 30 in. deep at the central portion between the cross-ties, tapering to 12 in. at the point of juncture with the bolsters, with four 3½x3½x5⁄8-in. angles at the bottom of the webs, two 3½x3½x⅜-in. angles at the top and one 24x⅜-in. top cover plate. The side trusses consist of 24x5/16-in. web plates with one 3x4x5⁄8-in. angle at the top, one 3x4x⅜-in. and one 3x3x5/16-in. angle at the bottom. The top angle is placed on the inside of the web plate forming a foot rest. The 5/16-in. angle is placed outside of the web plate and carries the wood nailing strip to which the side sheathing is secured. The center construction is designed to resist the pulling and buffing shocks and to carry a proportion of the load, while the side trusses take care of the balance of the load.

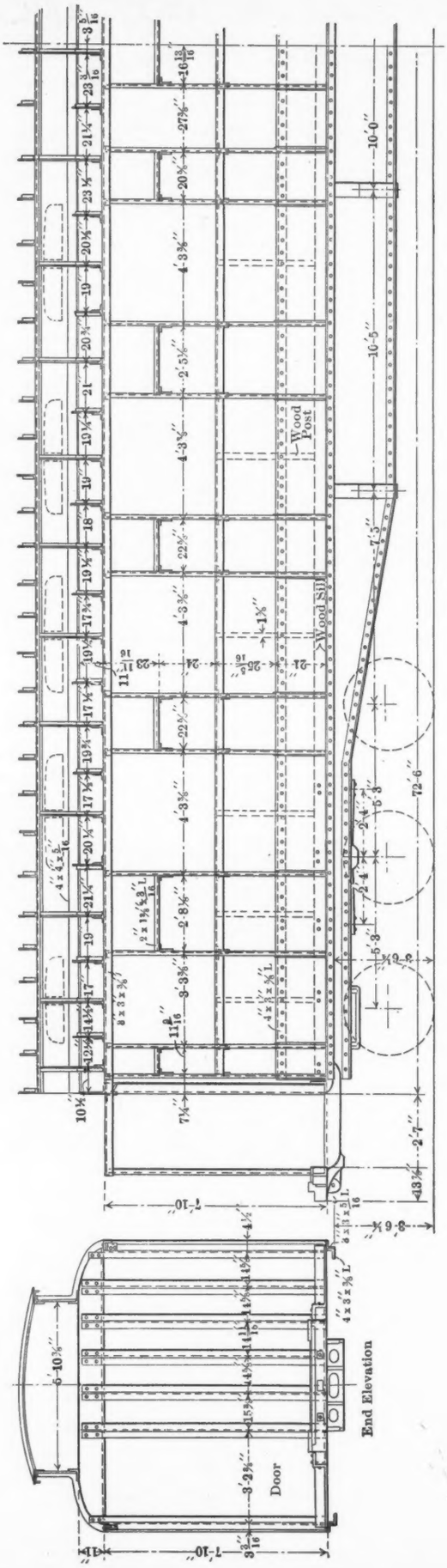
There are four Commonwealth Steel Co.'s cast steel cross-ties and center filler castings per car, all being 30 in. deep, the object being to equalize and distribute the load between the center construction and the side trusses. The floor supports between the cross-ties are 4-in. channels.

Eight 4-in. "Z" bars at each end of the car, the lower ends extending down into pockets cast in the steel platform and riveted to the end sill sections, form the end framing and anti-telescoping device. The upper end of each of these "Z" bars has the web cut out and the inner flange pressed back even with the outer flange, and both flanges are riveted to a pressed steel end plate, which in turn is securely connected to the side plates and roof framing of the car.

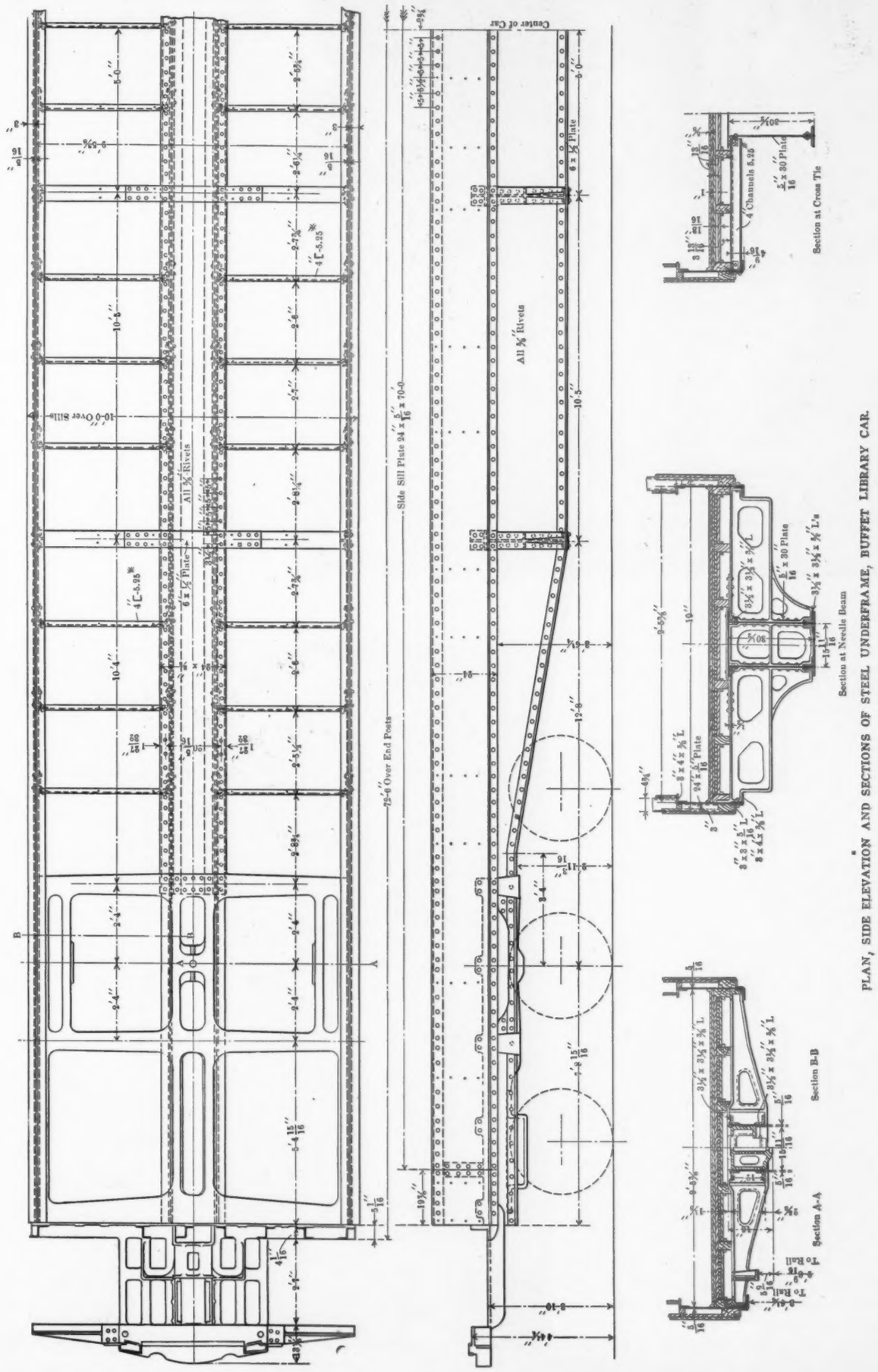
The side framing consists of 3/16-in. pressed steel channel-shaped posts running from the side plates to the bottom of the side trusses. Each of these posts extends the full depth of the side truss and has a large inner flange at this point, which provides an extremely large surface for securely riveting the post in po-



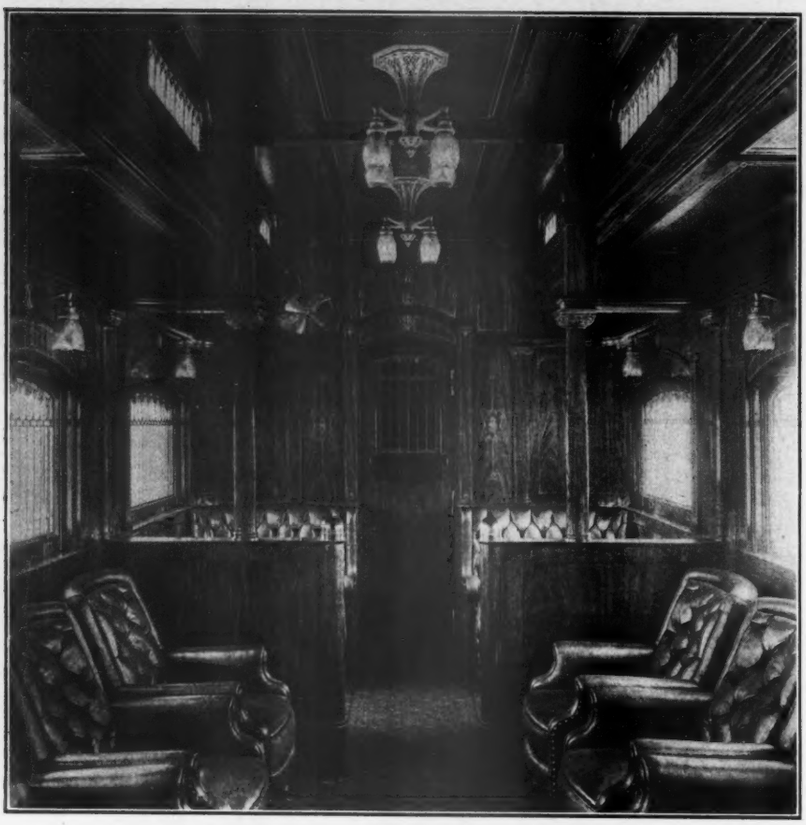
FLOOR PLAN OF BUFFET LIBRARY CAR.



END ELEVATION AND HALF SIDE ELEVATION OF FRAMING OF BUFFET LIBRARY CAR.



PLAN, SIDE ELEVATION AND SECTIONS OF STEEL UNDERFRAME, BUFFET LIBRARY CAR.



LOUNGING END, SHOWING STATIONARY SEAT SECTION.

the train or between sleeping cars, so that sleeping car passengers may enter it from either end, which was the feature that controlled the floor plan. This is likely to prove to be a most convenient and popular arrangement for passengers who want to use the car for reading or lounging.

The car is divided into two rooms with the buffet between them. The smaller of the two is the lounging room; the larger, the library or reading room. The former is finished in dark woods with subdued lighting and color effects; the latter in lighter tones with brilliant coloring. While both rooms suggest comfort and luxurious ease, the effect in the lounging room is toward relaxation, while the library reflects the well-ordered repose of a brightly lighted room for reading and social intercourse.

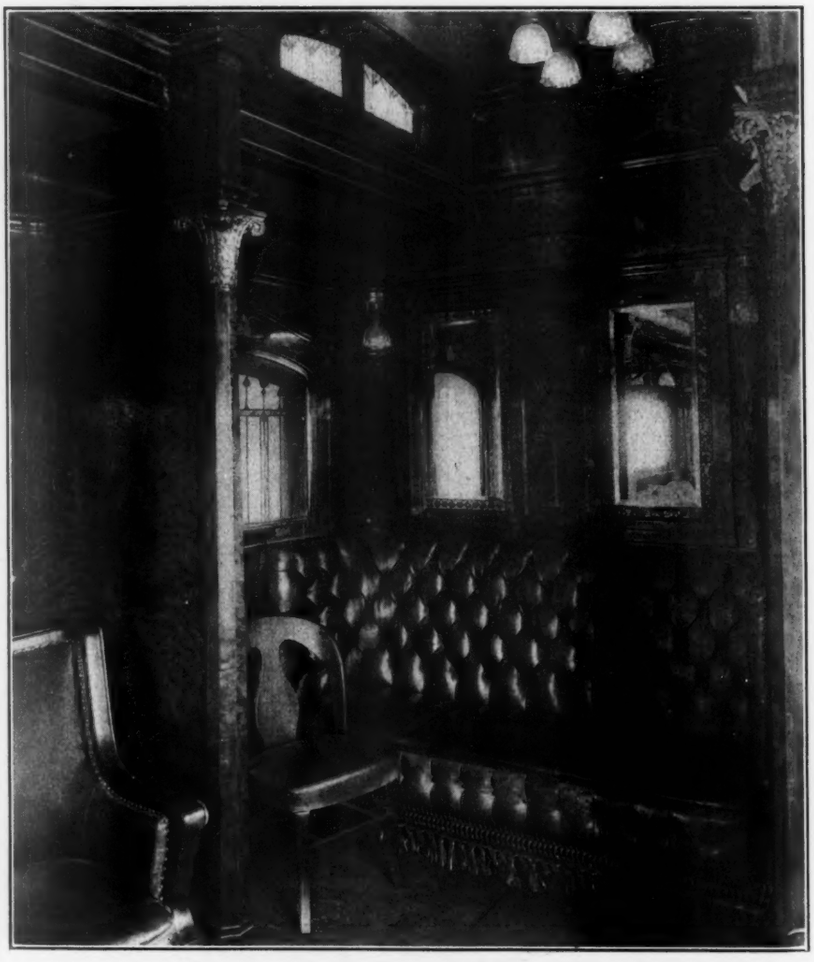
A dark wood, native to Peru, where it is known as "Quitacalcon," is used for the interior finish of the lounging room. The builders, who have used the wood for several years, have given it the name of "Peruvian Mahogany." It is finely figured and takes a perfect polish. The interior finish of the library end is in Cuban mahogany, beautifully marked. Delicately executed designs in marquetry of rare woods characterize the whole of the interior. All of the marquetry has had the special Barney & Smith treatment to preserve the natural colors of the woods.

sition. The side girths are composed of 3 x 5 x 5/16-in. angles fitted and riveted between the pressed steel posts. The side plates, which are continuous, are of 3 x 3 x 3/8-in. angles. The deck sills are continuous steel angles 4 x 4 x 5/16 in. The deck plates are of 3/16-in. pressed steel channel-shaped sections. The rafters, for both the upper and lower decks, are of angle section 2 x 1⅛ x 3/16 in. bent to shape and riveted directly to the deck sills and the deck plates, and secured to the side plates by malleable iron castings riveted to the lower deck rafter and the side plates.

Nailing strips are bolted to the side posts and the rafters for securing the outside sheathing, the roof, the inside finish and the headlining. Wood nailing strips are placed in the bottom framing for securing the flooring, there being one deafening floor below the sills, and the two upper floors. The finished floor is of "Flexolith" composition material, manufactured by the General Railway Supply Company. This composition is laid over expanded metal, which is attached to the upper course of wood flooring. The lower floors are further insulated with a course of 1½-inch hair felt placed between the floor nailing strips.

Extremely heavy draft and buffer attachments are provided, Miner friction draft rigging and Forsyth friction buffers being used. The trucks used under the buffet library cars are the Commonwealth cast steel six-wheel truck frame, equipped with Paige 38-inch wheels, Franklin journal boxes and Diamond special brake beams.

This car, instead of being placed at the forward end of the train, as is usual with buffet library cars, is to be placed in the middle of

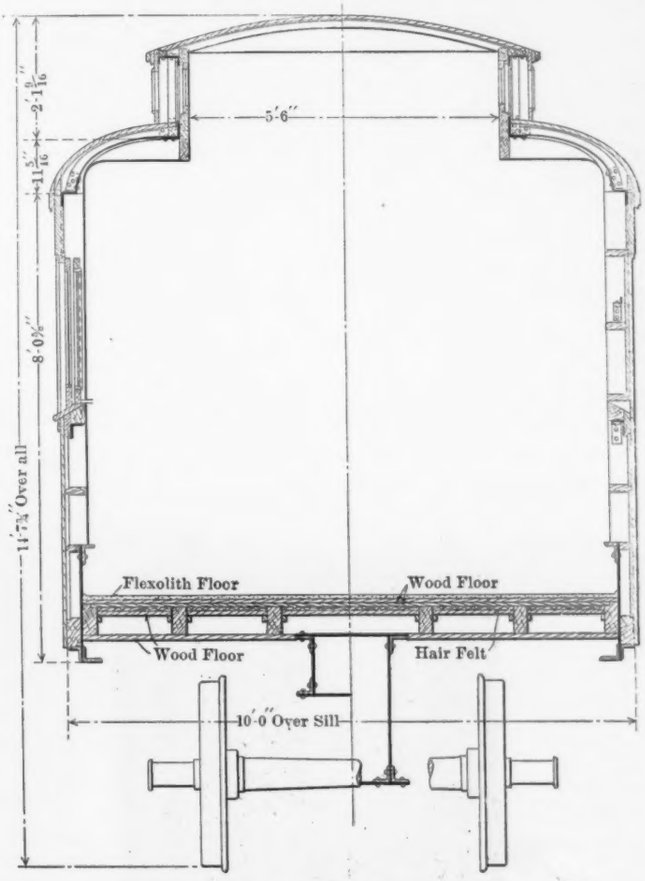


SOFA IN LIBRARY.

This treatment consists in carefully coating the marquetry after it is placed in position with a composition, which is removed after the ground work has been filled. This treatment gives a clean-cut contrast and naturalness to the marquetry that is lacking in much of this sort of decoration to be found in passenger car ornamentation.

One of the noticeable features of the interior is the entire absence of square or angular corners in the library room. The bulkheads, side walls and partitions have round corners, forming a continuity of line which gives a pleasing relief from the usual box effect and thereby contributes to the general air of comfort and repose, which is the characteristic idea throughout.

The idea of the curved lines is carried into both the lower and upper deck in the library room and appears both in the ogee curve in the headlining and in the coloring, which gives an impression of height and roominess that is most attractive. This general effect of roominess is much enhanced by the height of



CROSS-SECTION OF FRAMING OF BUFFET LIBRARY CAR.

the windows. All of the windows stop at the chair rail line and the result is an impression of bulk and strength on the exterior and altitude and space on the interior.

Electroliers specially designed to suit the general theme and finished in statuary bronze are provided. Those in the lounging room have iridescent shades while those in the library end have Holophane shades. The inside windows are of leaded glass with a combination of polished French plate combined in designs of richly colored cathedral glass. The glass in the deck sash is of the same general character.

In the lounging room, the ceiling is finished in canvas and is paneled with massive beams and painted a rich red slightly relieved with gold line ornamentation. The carpets are of the best Wilton. The chairs, sofas and cozy corners are upholstered in Spanish leather in shades to match the color schemes of the several rooms.

The cars weigh about 153,000 lbs.

CINCINNATI CONTINUATION SCHOOLS.

About three years ago, Houston, Stanwood & Gamble established a school in their own shop, giving instruction to their apprentices during shop hours. Their experience was so profitable that about a year later the Cincinnati Milling Machine Company established a similar school. We first attempted to operate this school at night, but, because of the difficulty in insuring an attendance on the part of the boys, we soon decided to also operate this school during working hours. These two schools were noticed by other manufacturers, and were also brought to the attention of the Board of Education. After a number of conferences between the manufacturers and the members of the Board of Education it was decided, beginning with September, to operate a continuation school under the auspices, and at the expense of the Board of Education. It was agreed by the manufacturers that they would send their apprentice boys and other young men to this school four hours per week, paying regular wages while the boys were in attendance.

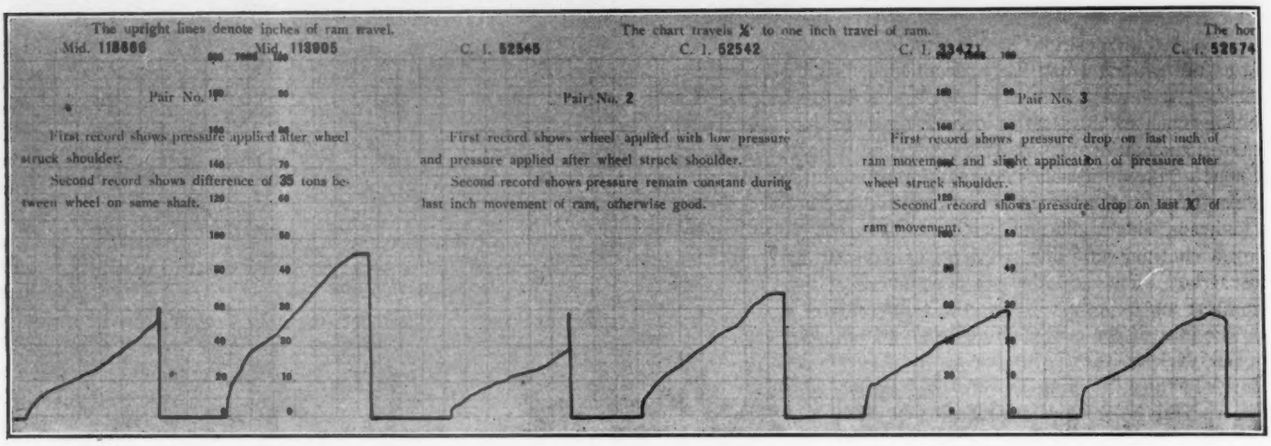
Over 200 boys are now enrolled, and, as fast as additional teachers can be provided, there is no doubt that this enrollment will be very greatly enlarged. You must remember that, at present, the boys that attend the continuation school are all employed in machine shops. The course has not yet been brought to embrace the other industries in Cincinnati. The classes of this continuation school are limited to about 20 boys. They are taught elementary and higher mathematics, including problems in geometry and trigonometry. The whole plan of the school is to teach directly the problems that the boy encounters in the shop. The catalogue and blue prints of the machine manufacturers of Cincinnati are the text books, and through the co-operation of the superintendents and the engineers employed in the shops of Cincinnati the work done at this school to-day is probably more practical and more effective than of any school in this country or in Europe. The efficiency of these boys in the shop is already showing substantial improvement, and will increase as the teaching force and courses at this continuation school are amplified.—*Frederick A. Geier, before the National Machine Tool Builders' Association.*

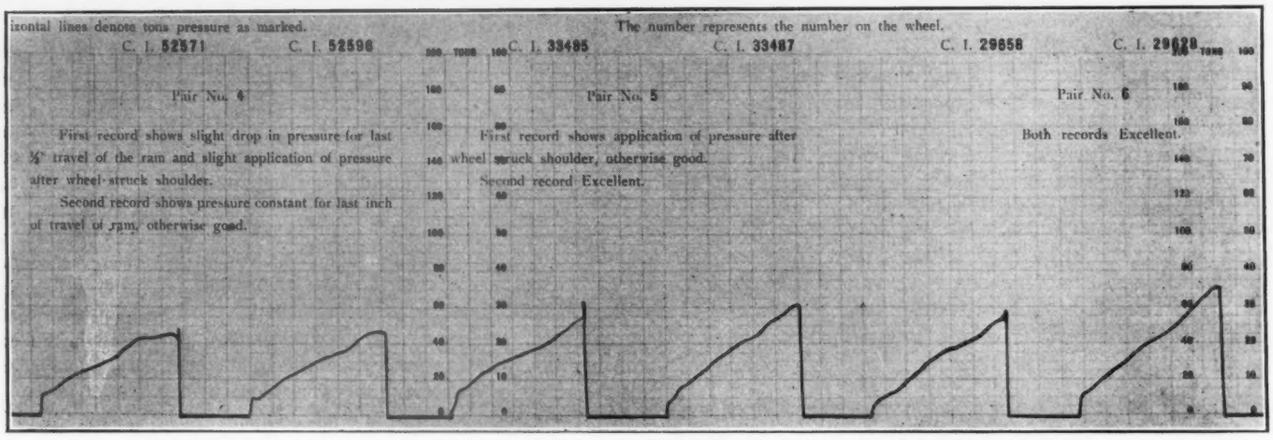
TRESPASSING ON RAILROAD PROPERTY.

Trespassing on railroad property, in violation of the law, has been responsible for the deaths of 47,416 people in the United States in the last ten years. In the same period, more than 50,000 trespassers were injured. It is in view of these facts that many of the important railroads have determined to redouble their efforts to secure in this country that rigid enforcement of the law against trespassing, which, in England, has reduced the practice—and accidents to trespassers—to a minimum.

The number of people killed while trespassing on railroads has been increasing every year. In 1898, 4,063 trespassers lost their lives on American railroads; five years later the number was 5,000, and in 1907, the number killed was 5,612—more than 15 a day. These figures are taken from the annual reports of the Interstate Commerce Commission.

The alarming death roll from trespassing on railroad property, which from 1899 to 1909 was nearly four-fifths of that suffered by the entire Union Army in all of the battles of the Civil War, is every year charged up to the railroads, even though these people were killed while violating the law and under conditions over which the railroads have no control. The co-operation of state and county authorities has been solicited, but actual punishment of persons violating the laws forbidding trespassing on a railroad's private property has been infrequent. The cost of imprisonment has deterred the local courts from holding those arrested while trespassing on railroad property. The practice of walking on railroad tracks has been growing constantly, and the number of people killed and injured increases with it.


The upright lines denote inches of ram travel.
The chart travels ½" to one inch travel of ram.
Mid. 118686
Mid. 113905
C. I. 52545
C. I. 52542
C. I. 52574
Pair No. 1
Pair No. 2
Pair No. 3
First record shows pressure applied after wheel struck shoulder.
Second record shows difference of 35 tons between wheel on same shaft.
First record shows wheel applied with low pressure and pressure applied after wheel struck shoulder.
Second record shows pressure remain constant during last inch movement of ram, otherwise good.
First record shows pressure drop on last inch of ram movement and slight application of pressure after wheel struck shoulder.
Second record shows a pressure drop on last ½" of ram movement.


izontal lines denote tons pressure as marked.
The number represents the number on the wheel.
C. I. 52571
C. I. 52596
C. I. 33485
C. I. 33487
C. I. 29658
C. I. 29628
Pair No. 4
Pair No. 5
Pair No. 6
First record shows slight drop in pressure for last ½" travel of the ram and slight application of pressure after wheel-struck shoulder.
Second record shows pressure constant for last inch of travel of ram, otherwise good.
First record shows application of pressure after wheel struck shoulder, otherwise good.
Second record Excellent.
Both records Excellent.

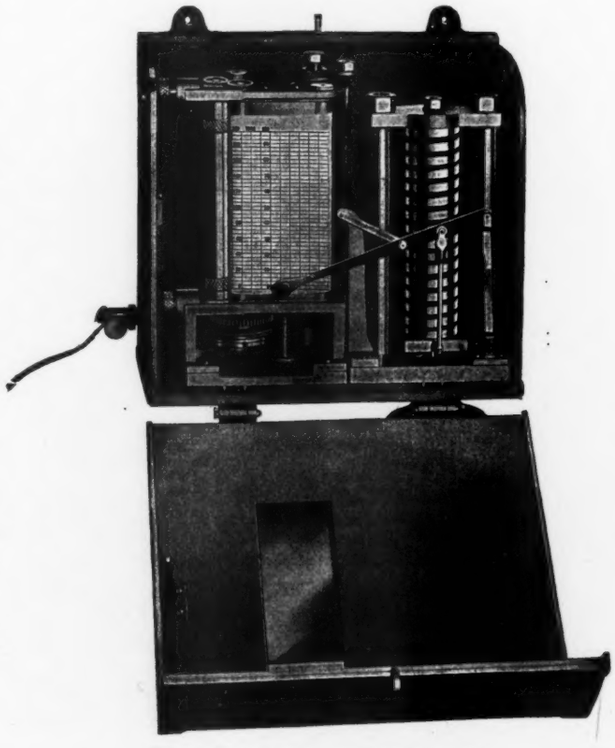
TYPICAL DIAGRAMS MADE BY THE HYDRAULAGRAPH IN PRESSING ON WHEELS. THE LARGER CAPACITY SCALE WAS USED. A LIGHTER SPRING MAY BE FURNISHED FOR WORK REQUIRING LESS THAN 100 TONS PRESSURE.

THE HYDRAULAGRAPH.

In pressing wheels on axles in a hydraulic press it is customary to specify a certain maximum pressure which shall be attained, or not exceeded. This pressure will, under proper conditions, be reached just before the wheel strikes the shoulder on the axle, having increased in a constant ratio from the beginning of the operation. Because of the usual presence of the shoulder on the axle it is possible for a workman, either intentionally or accidentally, to obtain the required pressure on his gauge with a loose fit after the wheel has been completely pressed on and is against the shoulder and in this manner a wheel may be passed which is dangerously loose upon the axle.

To eliminate any possibility of this being done a new instrument has been designed by the American Steam Gauge & Valve Mfg. Co., of Boston, for application to hydraulic wheel presses, which has attracted much attention among railway mechanical men. By means of this instrument a diagram is obtained in a form very similar to the speed record from a Boyer speed recorder, which shows the exact pressure and movement of the wheel relative to the axle at all points in the operation. Such a record gives an exact graphic account of the conditions under which the fit was made and makes it possible to reject at once an unreliable pair of wheels, which might otherwise be placed in service and cause a bad accident.

The Hydraulagraph is built on the general design of a continuous steam engine indicator, but adapted to hydraulic work. It comprises a spring of great power of resistance and unerring accuracy, resisting the movement of a piston in a small cylinder connected to the chamber of the ram. By means of this and an air chamber for taking up the vibrations a diagram is obtained by a pencil point with a parallel motion, which gives as clear a line as a steam engine indicator. The card on which the diagram is drawn is arranged, as shown in one of the illustrations, so that it obtains its movement from a connection to the ram of the press.



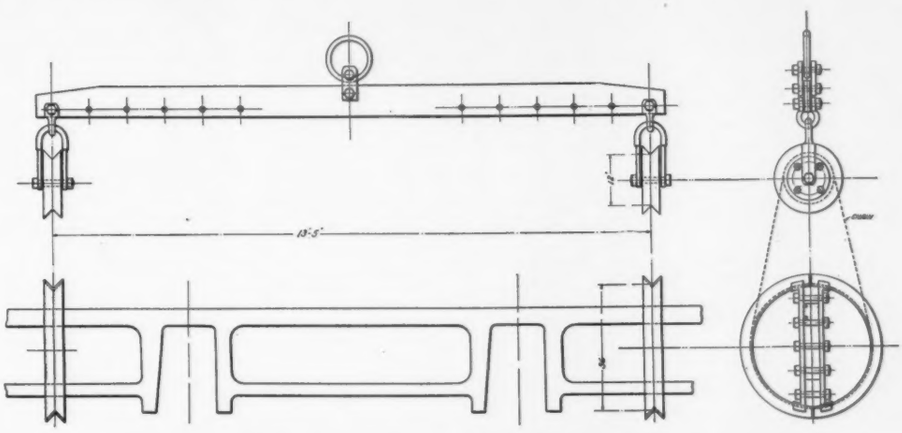
INTERIOR OF THE HYDRAULAGRAPH.

On this machine the moment the operator attempts to get the

required maximum pressure on a loose fit the diagram shows a vertical line. There is no way of disguising this, neither can the operator by any means obtain access to the diagram or pen. In fact, any effort on his part to hold the pen would only result in breaking it. The only portion of the diagram accessible to the operator is a marginal space left purposely for him to record the wheel data.

One of the illustrations shows a section of a chart with diagrams obtained in actual practice which are self-explanatory. The chart is 100 ft. long, each one-quarter inch representing a one-inch movement of the ram, and a roll can thus easily record 400 complete movements or 200 pairs of wheels. The records shown contain comments pointing out the features of each operation.

In the rolling stock equipment of steam or electric railroads there is probably no part on which safety so much depends as upon the strength and reliability of the truck. In this the most unreliable factor and the one least capable of accurate inspection has been the security with which the wheels are held on the axle. It is believed that by means of the Hydraulagraph this difficulty will be removed and that, together with the usual tests for determining the safety of other parts of the truck, it will now be possible to turn out a completed truck with a very fair measure of dependability.



ADJUSTABLE EQUALIZER FOR HANDLING LOCOMOTIVE FRAMES WITH A CRANE.

WELDING LOCOMOTIVE FRAMES.

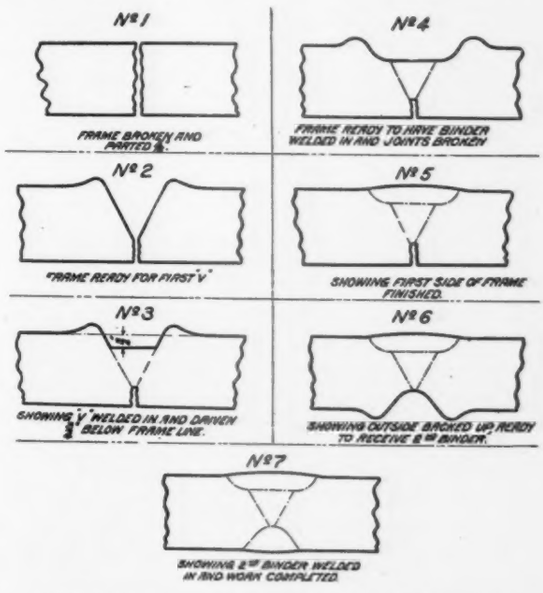
In making a report before the International Railroad Blacksmith's Association, J. E. Carrigan, master smith of the Rutland Railroad, directed attention to a new form of weld which they are using for locomotive frames.

"Instead of using the regulation V weld in making repairs, we have gone one better and adopted the plan of using one V and two binders, as shown by the sketches, being particular to select the best stock at hand for the V and the binders, and to have the grain in them run in the same direction with that of the section to be repaired. We are obliged to do this work with sledges, not having any steam hammer, and we contend that it is the best and strongest weld possible to be made with sledges, and think a man with a steam hammer might consider it profitable to himself and his company.

"We use an adjustable equalizer for handling the frames, suspended from a quick-acting chain-falls, which allows us to raise or lower it easily; the equalizer is made 1½"x8"x14' long, as shown by the drawing. We have no trouble in striking a balance on the length of any frame—with an equalizer made in this way. The frame wheels are thirty-six inches in diameter on the bearings, and it is an easy matter to get a balance crossways of the frame, by placing the heavy section of the frame nearest the center of the wheel. With a wheel of this size there is no need of using scrap iron for counterbalance, and it will take in and can turn over the lightest or heaviest of frames with very little trouble.

"We have a frame fire in the Rutland shop that I can recommend to anyone wanting the handiest thing possible in that respect, and that is a portable forge, connected to the blast pipe with a hose or to the compressed air. You can set it anywhere, on either side of your hammer; and when you come to do the work with sledges on a block—in a small shop—it is perfection When the job is done all you have to do is to disconnect it and truck it out of the way until the next frame comes along."

A. S. M. E.—At the New York November meeting of The American Society of Mechanical Engineers, to be held on the 9th in the Engineering Societies Building, 29 West 39th street,


№1
FRAME BROKEN AND PARTED
№4
FRAME READY TO HAVE BINDER WELDED IN AND JOINTS BROKEN
№2
FRAME READY FOR FIRST V
№5
SHOWING FIRST SIDE OF FRAME FINISHED.
№3
SHOWING V WELDED IN AND DRIVEN BELOW FRAME LINE.
№6
SHOWING OUTSIDE BACKED UP READY TO RECEIVE 2ND BINDER.
№7
SHOWING 2ND BINDER WELDED IN AND WORK COMPLETED

NEW METHOD OF WELDING A LOCOMOTIVE FRAME.

at 8:15 o'clock, there will be two papers presented, one by Prof. Gaetano Lanza and Lawrence S. Smith, of The Massachusetts Institute of Technology, on reinforced concrete beams, and the other by Prof. Walter Rautenstrauch, of Columbia University, on stresses in curved machine members.

TELEPHONES ON FREIGHT CABOOSES.—The Atchison, Topeka & Santa Fe Ry. will equip all of its freight cabooses with telephone instruments. When a freight is left on a siding some distance from a telegraph office or there is an accident on the main line that should be reported immediately, the trainmen will make connection with the telegraph wires by means of an extension pole that is carried in the caboose and arranged in joints.

THE EFFICIENCY OF FILES.*

The following inquiry regarding files has been made not merely for the benefit of the file-maker, but quite as largely for the benefit of the buyer and user of files. The subject, therefore, is treated from the standpoint of a practical engineer without any special knowledge of file making.

The testing of files is accomplished by means of a special machine † which records the endurance and metal-removing qualities of the file on a piece of paper wound around a cylinder, thereby producing diagrams as shown in Figs. 1 and 2. In these diagrams the horizontal distances represent the number of strokes made by the file tested, and the vertical distances the number of cubic inches of metal removed during the life of the file. The curves drawn in Fig. 1 show the life history of two files from the time when they were new until they were completely worn out. It will thus be seen, for instance, that one file removed somewhat over eight cubic inches of steel in 108,000 strokes, after which the file was incapable of removing any more metal. The other file removed the same amount of material in the first 16,000 strokes, and was still in good condition, removing a total of 14 cubic inches in 42,000 strokes before being worn out. In Fig. 2 is shown even a more striking comparison, and here the great variation in the amount of work possible from files of different quality is exhibited. The two sides of one file removed

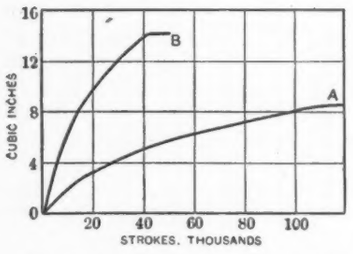


FIG. 1.—DIAGRAM RESULTING FROM FILE TESTS ON STEEL, MADE ON THE HERBERT FILE TESTING MACHINE.

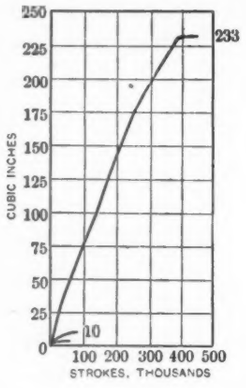


FIG. 2.—DIAGRAM RESULTING FROM FILE TESTS ON CAST IRON.

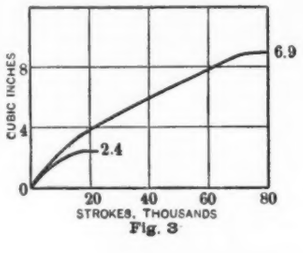


Fig. 3

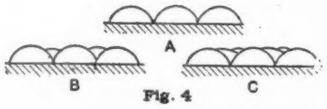


Fig. 4

FIG. 3.—CURVES RESULTING FROM TESTS OF TWO SIDES OF THE SAME FILE CUTTING THE SAME MATERIAL. FIG. 4.—ARRANGEMENT OF FILE TEETH, DUE TO VARIATION IN RATIO BETWEEN "UP-CUT" AND "OVER-CUT."

10 and 3 cubic inches, respectively, of cast iron before becoming too blunt to cut, while one side of another file reduced to filings nearly 20 feet of a cast iron bar one inch square before becoming unable to cut. These examples indicate that file testing is a matter of considerable importance in shop economy, particularly in the assembling department where a great deal of time may be wasted by using inferior files.

The files are tested until they slip over the surface of the test bar without cutting, this condition being shown by the curves taking a horizontal course. Tests which are stopped before this point is reached may give a false impression as to the relative merits of files. It may happen that two files cut equally well during the first 50,000 strokes, and if the tests were stopped at this point the files would be considered equal. If the tests were continued, one file might cease cutting at 60,000 strokes, and the other continue for 400,000 strokes, thus showing a great difference in their durability.

Results and Conclusions of File Testing.

Among the results obtained by the file-testing machine, perhaps none is of more interest than the discovery that the two sides of a file are seldom equal in efficiency and durability. Fig. 3 shows the curves for the two sides of the same file, one of which accomplished three and one-half times as much work and made four times as many strokes as the other. Such results are common. File-makers generally explain this difference as due to a variation in the sharpness of the chisel used in cutting the files. If a great variation is thus found between the sides of a file, it is likely that equally great variations will be found between individual files in the same lot, this being an evidence of lack of uniformity in the manufacturing process. One of the most important services, therefore, that is rendered by the file-testing machine to makers and users of files, is that of showing the great difference caused by minute variations in the shape of the file teeth, variations which can scarcely be detected by examination, and which can only be eliminated by extreme care in all the processes of manufacture.

It has been assumed that a file made of good steel is a good file. The teeth, of course, are expected to feel sharp, but beyond this very little attention has been paid to their shape. The file-testing machine has shown that the shape has a far greater influence than the quality of the steel, not only on the rate of cutting, but also on the amount of work that can be gotten out of the file. Fig. 5 shows the curves obtained from tests where five files were worn out at practically the same number of strokes (110,000). The amount of iron filed away varied very greatly. These variations in rate of cutting are more marked on cast iron than on steel. The best file in Fig. 5 cut when new at the rate of 14 cubic inches per 10,000 strokes, while the poorest file cut hardly more than ½ cubic inch during the same number of strokes, the material being cast iron. On steel a rate of 6 cubic inches per 10,000 strokes is rarely exceeded.

The rate of cutting is given by the slope of the curve and depends almost exclusively on the shape and sharpness of the teeth and on their relation to one another, and is not affected by the quality of the steel. As many files cut at a very slow rate when considerably worn, it is economical to reject files at a fairly early stage of bluntness.

Factors Determining Efficiency of Files.

The chief factors by which the cutting efficiency of a file is determined are:

1. Sharpness of teeth.
2. Slope of the front face of the teeth, or rake.
3. Slope of the back face of the teeth, or clearance.

4 and 5. Angles of the two cuts relative to the axis of the file.

6. Pitch or coarseness of the cut.
7. Ratio between the pitch or number of cuts per inch in the "up-cut" and in the "over-cut."

At first sight it would seem that the sharpness of the teeth would be the most important factor in cutting efficiency, but the experiments indicate that this is not the case. Two files equally sharp, and thus cutting equally fast when new, do not show the same efficiency.

* Abstract of paper by Edward G. Herbert, read before the Manchester Association of Engineers, March 27, 1909.

† For description of the machine for testing files see American Engineer and Railroad Journal, page 466, December, 1907.

The slope of the front face of the teeth on commercial files as made at present is very rarely vertical, but in almost all cases there is a negative rake varying from 3 to 25 degrees. Experience with lathe and planer tools would lead one to expect that a tool with considerable negative rake would be exceedingly inefficient on almost all materials, and it is surprising that such a tool cuts at all under such light pressure as can be applied by hand on a file. Nevertheless it is a fact that files with considerable negative rake not only cut, but take off very satisfactory curled chips. The reason for this is probably that the file tooth is presented to its work at an angle, owing to the slope of the cut across the file. This gives a slicing cut, which probably accounts for this efficiency.

The slope of the back face of the tooth, or clearance, is very difficult to measure because it is not a plane surface, but the angle is very important in relation to the durability of the file. A file which is worn out has the tops of its teeth flattened or rounded. When the area of contact of the teeth with the work attains a certain value, great pressure is required to cause the teeth to "bite" the metal. The amount of work that can be obtained from a file, therefore, depends largely on the volume of teeth available for wear before this limiting area is obtained.

Examination of commercial files show that these angles are extremely variable, and it is certain that uniformly satisfactory results cannot be obtained unless correct angles are ascertained

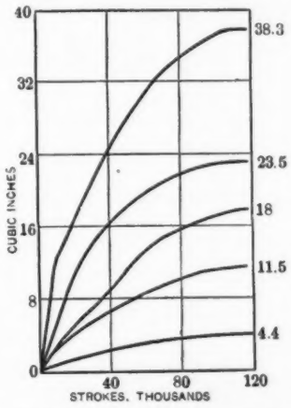


FIG. 5.—FIVE FILES OF EQUAL DURABILITY, BUT UNEQUAL CAPACITY, FOR REMOVING METAL.

and maintained, leaving nothing for the variation of judgment on the part of the workmen. The pitch or coarseness of the cut does not seem to influence the efficiency of files to any great extent. Very coarse files, however, are almost always inefficient, probably because of the difficulty of raising very large teeth, which are at the same time sufficiently thin and sharp. Very smooth files, on the other hand, cut slower and do less work than those of a somewhat coarser cut, but in some cases surprising results have been obtained from smooth files also.

It may not be generally known that the two cuts on a file differ in pitch. Suppose a file had 25 cuts in the chief or "up-cut." If it has also 25 cuts per inch in the secondary or "over-cut" a cross-section of the file would appear as at *A*, Fig. 4, each tooth standing immediately behind a tooth in the row in front, and all the teeth lying in straight rows parallel to the axis of the file. Such a file would leave on the surface of the work a series of furrows with ridges between them. Now suppose that there be 25 cuts per inch in the "up-cut," but the "over-cut" is made with 16¾ cuts per inch. Then the appearance of the cross-section would be as at *B*. Each tooth now lies opposite the space between the two teeth in the row in front. The teeth in the first row still make a series of furrows, and the teeth in the second row work on the ridges between these furrows, planing them off and leaving a fresh series of furrows, but the file would be inefficient because the ridge between any two teeth would be too large to be taken off at one cut by the teeth behind. If the number of teeth per inch in the "over-cut" is increased to 19, the effect will be as shown at *C*; the ridges between the teeth in the first row are divided between the teeth in the second and third rows behind. This subject of the ratio between the "up-cut" and "over-cut" is likely to be one of the most important factors in file efficiency, but it has not as yet been thoroughly investigated.

EFFICIENCY OF FILES ON VARIOUS METALS.

It has generally been assumed that a good file is good for all classes of work, brass, cast iron or steel. Some difference of opinion on this subject has been expressed, and there has been a fairly general agreement that a file for brass should have the "up-cut" nearly at right angles to the axis, although this is by no means a general rule. In view of this a series of experiments was planned to ascertain whether there is one particular cut which is best for all metals, or whether each metal requires a special cut to produce the best results. For these tests a number of files were ordered from several makers who were asked to cut them in the manner which they considered most suitable for cast iron, steel, brass, and general work, respectively, each maker supplying a number of files for each purpose.

In the experiments each file was tested on brass, cast iron, mild steel, annealed tool steel and "normalized" tool steel, the last being subjected to heat treatment which would make it uniform in hardness throughout its length without actually annealing it. In one case a brass file gave the best result on brass, but this was the only instance where the best result on any metal was obtained by the file intended for that metal. In the test on cast iron, for instance, two files intended for steel cut more than three times as fast as the files intended for cast iron. On the "normalized" tool steel (not annealed) the cast iron file gave best results. The conclusions of these tests, therefore, showed:

1. The subject of files for specific purposes has practically received no thorough attention. As a rule, files cut for specific purposes gave poor results on the materials for which they were intended, and good results on materials for which they were not intended.

2. Files especially well adapted for any one metal did not give good results on other metals.

3. Files which showed average efficiency on all metals were rather inefficient on all.

4. The tests clearly show that the ductile metals, such as mild or annealed steel, are most easily worked with a sloping cut, which usually produces curled filings. Cast iron and hard brass require a much less sloping cut. Brass files, in fact, should have an "up-cut" almost at right angles to the axis of the file.

5. As a general conclusion, therefore, it appears that it would be advantageous to have files especially cut for various metals and keep them on the work for which they are intended. Most files intended to cut all metals are decidedly inefficient on them all.

It will rest with the user to make the first move in the matter. The file-maker is naturally reluctant to double or triple his stock and to make files for all the existing sizes, shapes and cuts in two or three distinct styles, suited to different metals. The difficulty may involve a slight increase in the price of files, but the increase in efficiency will be out of all proportion to the increase in cost.

Another evidence of the un-uniformity of files and the incomplete understanding of the subject, even by file-makers, is shown by the fact that sometimes files of two or three different qualities are sold by the same maker at different prices. In most, though not in all, cases where such files were tested, it was found that the cheapest grade gave the best result, and the most expensive the worst. This is probably explained by the fact that by a "good" file, the file-maker almost invariably means simply a file of expensive steel.

Most of the leading British file-makers are now investigating, with the aid of the testing machine, the various problems connected with file efficiency. This investigation is attended with special difficulty. Apart from the quality of the steel there are at least eleven important factors, all having an influence on efficiency: seven angles, the sharpness of the chisel, the force of the blow, the coarseness of the cut, and the ratio between the

two cuts. It is possible to make an infinite number of combinations of these eleven variables, and an alteration in any one of them is likely to affect several of the others. The problem is, therefore, greatly simplified if a simple file tooth can be isolated and its cutting efficiency measured under constant conditions while progressive changes are made in its shape and in the angle of its presentation to the work.

A Tool Steel Testing Machine.

The simplification of the problem mentioned is made possible by the use of a recently-designed tool steel testing machine. (This is described fully in Mr. Herbert's paper.)

By means of this machine it will be possible to ascertain what is the theoretically correct shape for a single file tooth for any particular metal. This information having been obtained, it will rest with the file-maker to ascertain by means of the file-testing machine what combination of theoretically correct file teeth gives the best maximum efficiency and durability to the file.

In relation to commercial file-making, the most important conclusion of the tests made with this machine appears to be that the least desirable results of all were obtained with the tooth which most closely resembled the commercial file tooth. The best results of all were obtained with a form of tooth which can probably be reproduced without great difficulty, but which appears never to have been adopted. This tooth would have a positive front rake of 15 degrees, and a clearance of 5 degrees. It was previously shown that the clearance angle is a most important factor in determining the total output and that the tool with no rake and only 5 degrees clearance will do only a very small amount of work, but it appears that a tool with the same clearance angle and with positive front rake will do an exceptionally large amount of work with great efficiency, and it is probable that by slightly increasing the clearance angle the output will be still further increased without undue weakening of the cutting edge.

Some caution will, of course, be necessary in applying the results just described to the art of file-making. These tests were made with what was practically a single isolated file tooth with a straight instead of a rounded cutting edge. The file is a series of round-nosed tools, lying very close together, and it may be found that a file with a positive rake will have a tendency to choke up with filings to such an extent as to neutralize its greater efficiency. The progress must be made by systematic experiments, confirmed at every step by the file-testing machine.

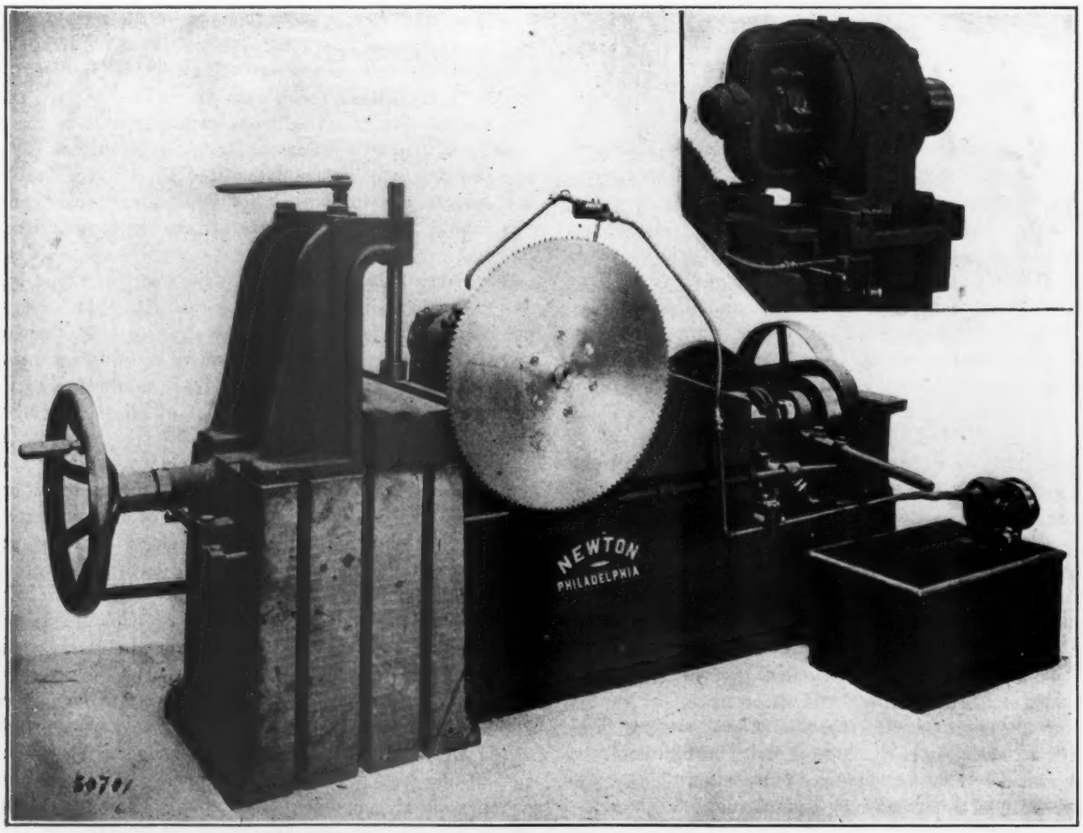
The results first described have a bearing on other cutting tools besides files. Of all the tool forms experimented with, among those that gave the smallest output of work was one having no front rake. This, however, is the usual form of tooth for milling cutters. There seems to be no reason for making milling cutters without front rake, except the well-known propensity of human beings to follow in their forefather's footsteps. Milling cutters with front rake have been made and tried, and have given good results, and yet it is impossible to buy such cutters without having them made to order.

COLD SAW CUTTING-OFF MACHINE.

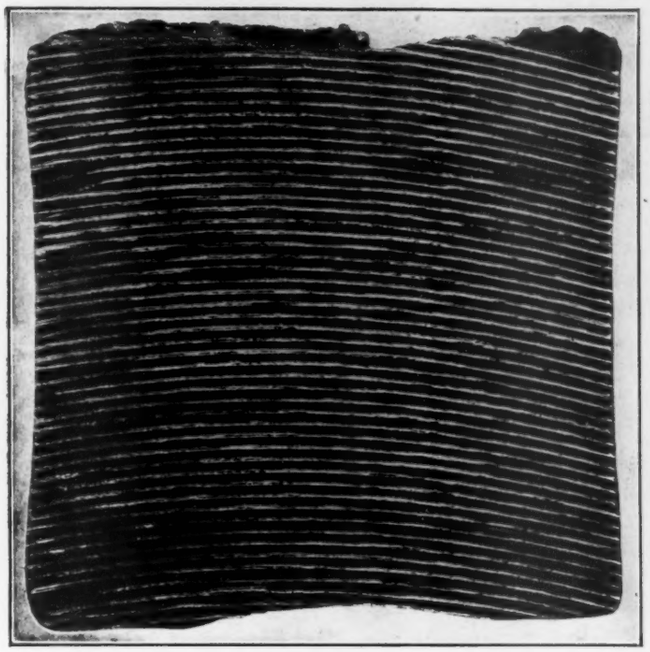
A 45 carbon steel bar, 8½ in. in diameter, was cut off in six minutes on the 28-in. cold saw cutting-off machine shown in the photo. One of the illustrations shows a section of a 10-in. square bar of 35 carbon steel that was cut off in six minutes on the same machine.

The table is arranged with both horizontal and vertical clamping surfaces adapting it for a wide variety of work, including the cutting off of gates and risers on castings. On some castings the risers may be clamped by the screws, leaving the body of the casting to overhang, while with others the casting may be clamped to the vertical surface, allowing the riser to drop after the cut has been made. These machines are made in sizes having capacities of 5, 7½, 9½, 11½ in., and larger, for special requirements.

The saw blade is 28 in. in diameter and is attached to the spindle by which it is driven by the flush bolts. The spindle is



COLD SAW CUTTING-OFF MACHINE. METHOD OF APPLYING ELECTRIC MOTOR SHOWN IN UPPER RIGHT-HAND CORNER.



SHOWING SECTION OF 10-INCH BAR OF 35 CARBON STEEL CUT OFF IN 6 MINUTES.

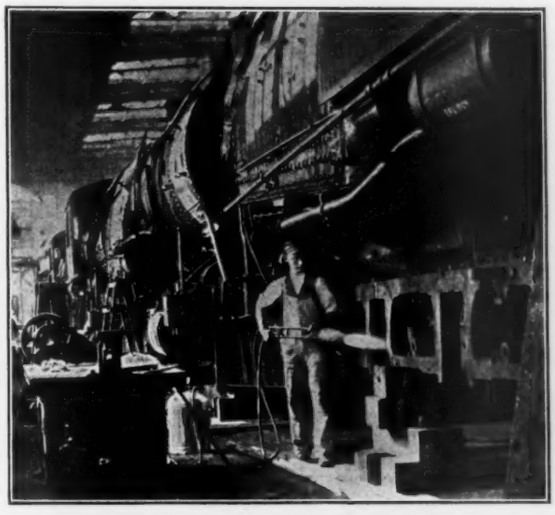
supported at each end by bearings of large diameter, which are capped, and is driven by broad-face coarse-toothed hammered steel spur gearing and a worm and worm-wheel; the worm-wheel has a bronze ring with triple lead teeth, and the worm is of hardened steel with roller thrust bearings. The saddle is of heavy construction in proportion to the capacity of the machine and has wide bearings on the frame; it is arranged on the saw side with square lock gibs cast solid, adjustments being made by a taper shoe. The feed is transmitted from the roller on the driving shaft to the disk, which is held to the proper tension by a spring adjusted by lock nuts. Operation of the roller on the driving shaft by the hand lever, shown in front of the machine, controls the rate of the continuous feed, which is variable from ⅛ in. to 1½ in. per minute. The saddle carries an arm arranged to trip the adjustable automatic and positive safety release to the feed. The machine is also fitted with a power quick return. When arranged for a motor drive, using a double throw switch or reversing motor, the fast power traverse is available in both directions.

The hand wheel, which controls the operation of the hand motion, is fitted to the end of the squared shaft and is removable to permit of machining sections that will extend beyond the hand wheel when bolted to the work table. Both the vertical and the horizontal surfaces have machined "T" slots for clamping the work. The clamps and V-block are separate castings and are made removable. These machines are furnished with a pump, piping and attachments for cutter lubrication and have ample rigidity for driving the modern inserted high-speed saw blades to their maximum capacity. As evidence of the powerful drive and heavy construction of these machines, it may be stated that for crank shafts and similar work the spindles are extended to carry two saw blades at one time, the rate of feed being the same as when only one blade is used. These saws are manufactured by the Newton Machine Tool Works, of Philadelphia, Pa.

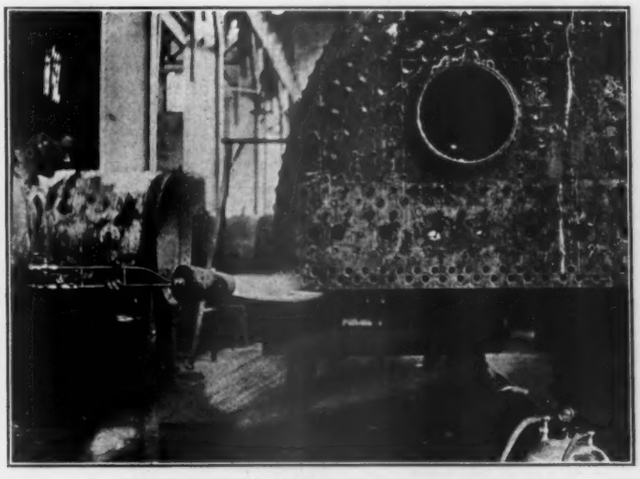
A NEW BURNER USING HYDRO-CARBON AS FUEL.

The refuse from a Pintsch gas manufacturing plant is commercially known as hydro-carbon and will produce a very hot flame when burned under proper conditions. The Hauck Mfg. Co., 90 West street, New York City, has, by a slight alteration in the burner which they have manufactured for a long time with great success when using kerosene or crude oil, been able to adapt it for use with hydro-carbon as fuel with a resulting flame of great intensity, which has proved to be particularly well adapted for railway shop uses at points where this refuse can be obtained. It has been found that this flame is excellent for use in the car yards for straightening bent parts of steel cars, in the boiler shop for laying up an obstinate corner or flange and in the frame shop for either straightening frames or for pre-heating preparatory to thermit welding. Frames can also be welded with this flame under proper conditions.

The burner used with hydro-carbon is but a slight alteration of the crude oil burner, which has made a reputation for economy and intensity. These burners are capable of use with an air pressure varying from five to 100 pounds, and in the largest size the burner weighs less than ten pounds.

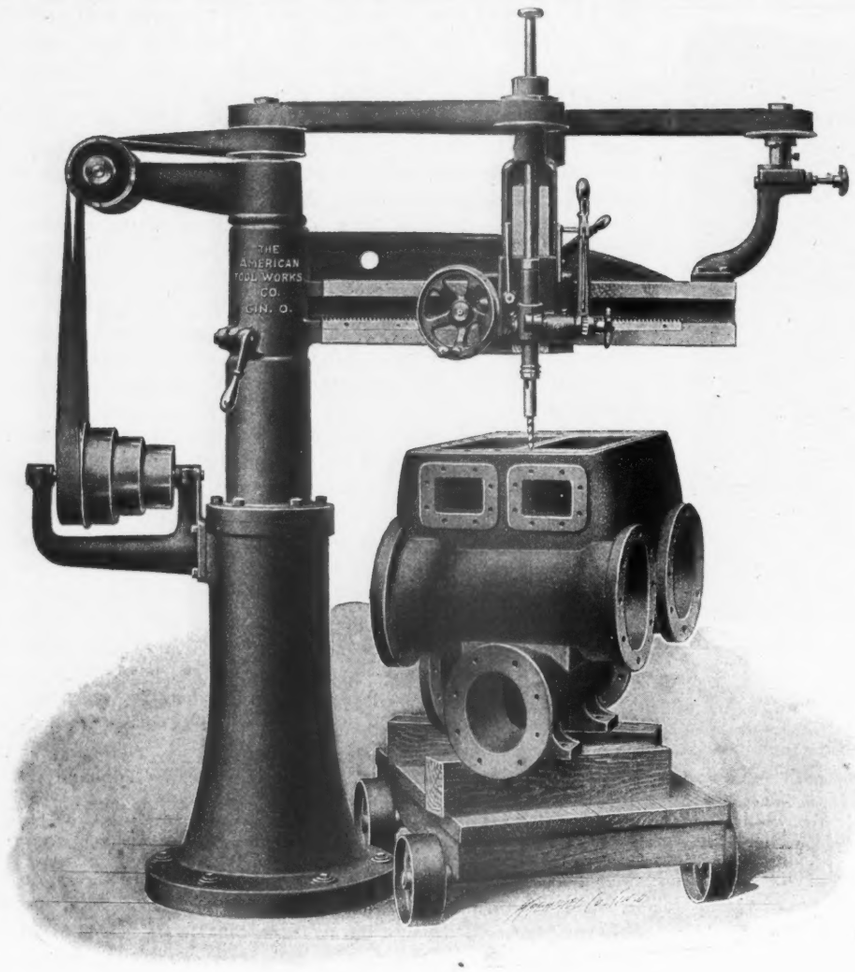


PRE-HEATING A LOCOMOTIVE FRAME.



USING HYDRO-CARBON BURNER IN BOILER SHOP.

NATIONAL SOCIETY FOR THE PROMOTION OF INDUSTRIAL EDUCATION.—This society will hold its annual convention at Milwaukee, Wis., December 1, 2 and 3. It is expected that some of the most distinguished leaders in the industrial, legislative and educational world will be present and make addresses. An exhibition of trade school work from all over the United States will be one of the features of the convention. State branches of the society have increased in number during the past year; Massachusetts and New York alone have more than 200 members each. The society has just issued Bulletin No. 9, which contains all the addresses delivered at the last annual convention held in Atlanta.



UNIQUE ARRANGEMENT OF SENSITIVE RADIAL DRILL.

HIGH SPEED SENSITIVE RADIAL DRILL.

In the May issue of this journal, page 210, was described what is believed to be the first sensitive radial drill made in this country. Since that time some tests and a couple of special applications have been made which are of interest.

One of the illustrations shows a machine of this type, with a 3-ft. arm, mounted on a pedestal base and not equipped with a box table. This machine is especially convenient in the drilling of holes in work which can be conveniently moved beneath the spindle of the machine on a truck, or otherwise. It does away with considerable handling of the work and permits of its being moved from the drilling department to the next one with the least possible delay. The arm is easily swung to the position desired and the head readily set at any point along the arm. Where drilling with a jig is practiced, the work is accomplished very rapidly. As will be noted from the test sheet a spindle speed of 900 r. p. m. is available, although this may be increased or diminished to suit special requirements. As all the bearings are of the ball bearing type, the drill will stand up to a speed of 2,000 r. p. m. without sign of distress, although, of course, no twist drill will hold an edge at such a speed.

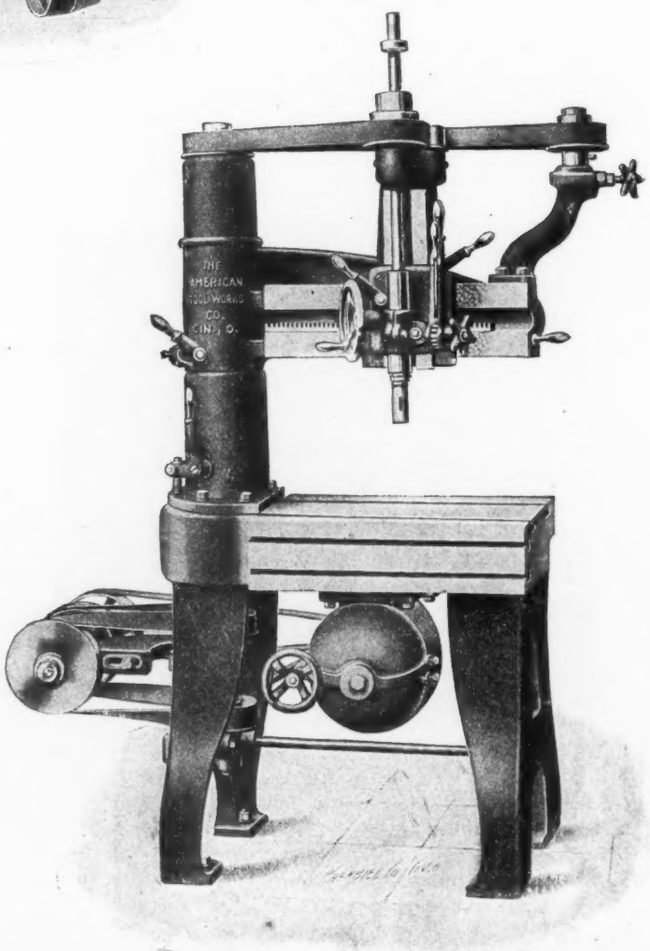
TEST OF AMERICAN HIGH SPEED SENSITIVE RADIAL DRILL.

Dia. of Drill.	Speeds. Rev. Per Min.	Speeds. Feet per Min.	Feeds. Aprx Per Rev.	Feeds. Inchs Per Min.	Net Horse Powr	Remarks.
¼"*	900	59			1.5	Cast Iron 1" thick.
½"	900	137.2	.022	20	1.50	" " " "
⅜"	900	147.2	.013	12	3.0	" " " "
¾"	900	177	013	12	3.7	" " " "
1"	455	119	.0066	3	2 6	" " " "
1"	785	207	.0076	6	3.2	" " " "
½"	900	137.2	.037	16.8	1.2	Aluminum Engine Frames. ⅛" thick. Drilled 14 holes in 25 seconds.
1 19-64	745	248			.9	Aluminum case. Drilled from the solid. Bosses drilled and faced in 1 operation

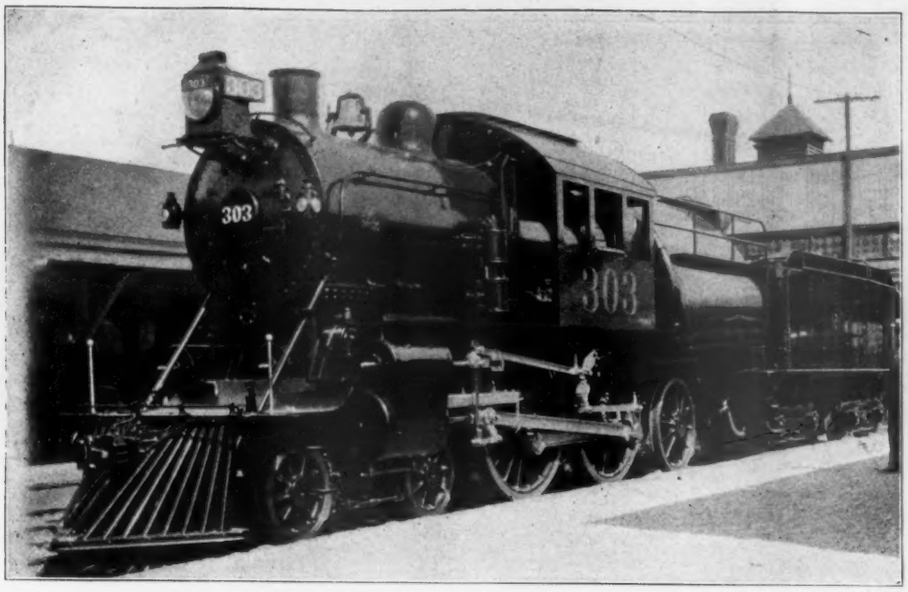
* Carbon steel drill; the others were all high speed steel.

The second illustration shows one of these machines, with a 2-ft. arm, equipped with a motor drive and a tapping attachment. The motor is mounted beneath the box table and is connected to the tapping attachment driving shaft by a belt. The motor is a Lincoln variable speed, 3 to 1, with speeds of from 525 to 1,575 r. p. m. These are controlled by the hand wheel on the motor. Many of the visitors at the Atlantic City convention, where one of these drills was exhibited, who operated the drill stated that it drilled into the metal as though it was wood, and as near as could be ascertained the ½-in. plate was drilled through with a ½-in. drill in two seconds.

The tapping attachment is perfectly controlled by the lever at the base of



MOTOR-DRIVEN SENSITIVE RADIAL DRILL.



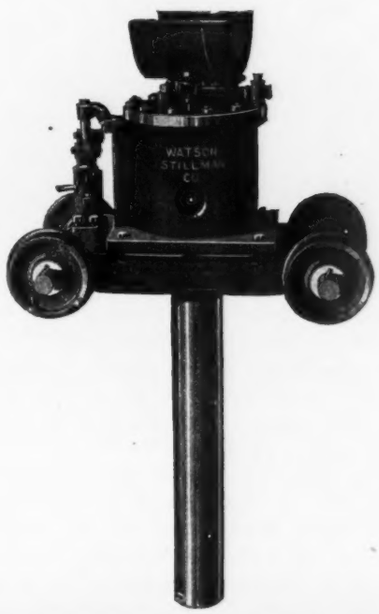
THREE-CYLINDER SIMPLE LOCOMOTIVE, PHILADELPHIA & READING RAILWAY.

the column in spite of the high speed of the spindle. The frictions in the tapping attachment are of a patented type which cannot become disengaged of themselves, after once being thrown in. They are of such large proportions as to transmit the maximum power required.

Adjustment for regulating the tension of the belts is arranged for both of the overhead belts and for those of the tapping attachment and motor drive. This drill will handle high speed twist drills and standard taps up to 1 in. in diameter. When fitted with a tapping chuck, it is particularly well adapted for the tapping of small holes. These machines are manufactured by The American Tool Works Company, of Cincinnati, Ohio.

HYDRO-PNEUMATIC PIT JACK.

The almost universal tendency to equip roundhouses and locomotive repair shops with air pressure pipe lines was recognized several years ago by the Watson-Stillman Company, of New York, when they introduced a new design of 15 and 30-ton pit jacks in which air pressure was utilized to accelerate the work of the jack. The favor with which this new operating principle was received has caused them to bring out a larger size to meet the increasing weight of modern rolling stock. The capacity of the new size is 45 tons. The jack illustrated, which was built for the St. Louis & Southwestern Railroad, runs on a 24-in. track, has a 4¾-in. ram with a 54-in. stroke, a clearance of 5⅜ in. from the rail to bottom of saddle, a height of 2 ft. 10 in. from rail to top of saddle when down, and extends down into the pit 3 ft. 7⅜ in. from the top of the rail.



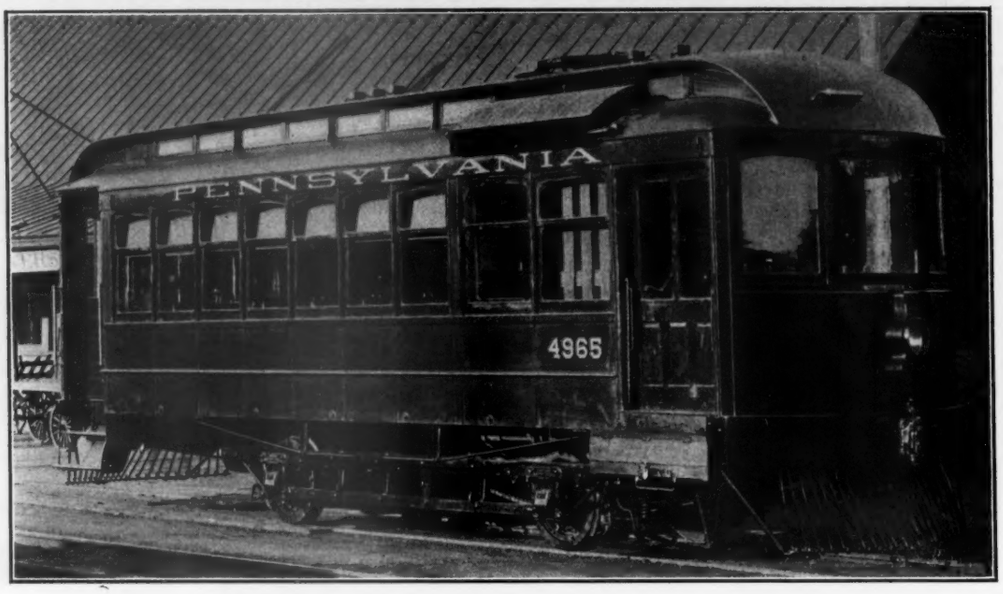
HYDRO-PNEUMATIC PIT JACK.

The hydro-pneumatic operating system gives the jack the quick motion of a pneumatic tool in moving the ram up to its work and thus effects a considerable time saving. After the jack has been placed in position, air pressure is admitted on top of the liquid in the cistern, thus forcing the water rapidly through the pump until the ram comes to a bearing under the load. A few strokes of the hydraulic pump will then raise the wheels sufficiently to remove the sections of track. The saddle is lowered in the usual way by the valve stem key.

THREE-CYLINDER SIMPLE LOCOMOTIVE.

During the last convention of the Railway Mechanical Associations at Atlantic City, there was on exhibition a most interesting high-speed passenger locomotive of the Atlantic type, which was built at the Reading shops of the Philadelphia & Reading Railway from the design of H. D. Taylor, superintendent of motive power. This engine has three simple cylinders 18½ inches in diameter, with 24-inch stroke, two being in the usual position and one on the center-line of the locomotive. The driving wheels are 80 inches in diameter and the total weight of the engine is 207,000 pounds, of which 112,000 pounds is on drivers. Each cylinder is fitted with a piston valve, the two outer ones being actuated by the Walschaert valve gear, and the inner ones by a valve gear of the Joy type. The cranks are set at 120 degrees, the crank pin being on the back pair of drivers for the outside cylinders and on the front cranked axle for the inside cylinder. The boiler is fitted with a superheater arranged somewhat similar to the Pielock design and located adjacent to the front flue sheet, in fact the front flue sheet is arranged to form the wall of the superheater. This is expected to give about 125 degrees of superheat.

The finish of the locomotive was particularly noticeable, there being many more highly polished parts used than is customary in this country. It presented a most imposing appearance on exhibition, and was examined with much interest by the members in attendance.



MOTOR CAR FOR USE ON SMYRNA BRANCH OF PENNSYLVANIA RAILROAD.

GASOLINE MOTOR CAR ON THE PENNSYLVANIA.

The Pennsylvania Railroad has inaugurated a gasoline motor car service on the Smyrna branch, between Smyrna and Clayton, Del. The car used was built by Fairbanks-Morse & Company and made the trip from their factory, Three Rivers, Mich., to Wilmington, Del., under its own power, in charge of J. Milliken, superintendent motive power of the Philadelphia, Baltimore & Wilmington. The distance of 780 miles was covered in 28 hrs. actual running time, or at the rate of 27.5 miles per hour.

The car is driven by a four-cylinder, four-cycle, water-cooled engine, heavy type, conservatively rated at 50-60 h.p. at 600 r. p. m. Under test it has developed 75 h.p. The power is transmitted through gearing, arranged to furnish three speeds in each direction. The gears are always in mesh, changes in speed being accomplished by sliding jaw clutches. The shafts run in roller bearings. Roller chain is used for transmitting the power to the axle.

As the car will be used on a short run, it is arranged with control at both ends. One small hand-wheel controls the different speeds and is arranged so that the clutch is released automatically whenever a change in speed is made; there is no possible way of damaging the transmission by throwing in more than one speed at the same time.

The body of the car is divided into two compartments. The forward one, 11 ft. long, contains the engine and has room for light baggage, express, etc. The rear compartment is 18 ft. long; it has reversible seats and a seating capacity for about 30 passengers. A gasoline tank of 50 gallons capacity is located underneath the body of the car and the gasoline is forced by air pressure to a small working tank in the engine compartment, which feeds to the engine by gravity.

The independent arrangement of the engine and the car body adds to the easy riding qualities; the body is carried on full elliptic springs on top of the truck frame, while the engine and transmission rest on the truck springs. The car is equipped with air brakes on four wheels, chime whistle and headlight.

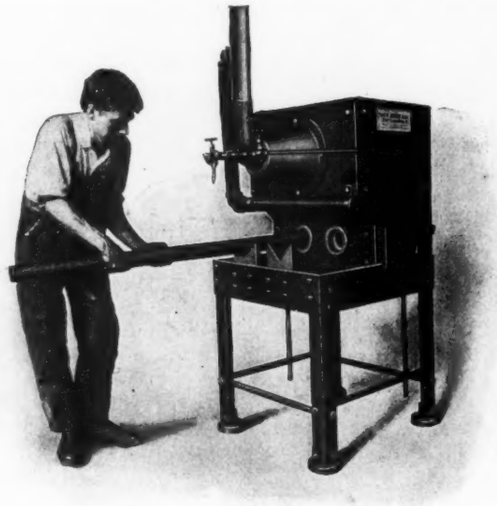
This is the fifth car of its kind built by Fairbanks, Morse & Co. Two are on the St. Joseph Valley R. R., LaGrange, Ind., one on Stanley, Merrill & Phillips Ry., Stanley, Wis., and one on St. Tammany, New Orleans Ry. & Ferry Co.'s line, Mandeville, La.

The September report of the Stanley, Merrill & Phillips car shows the following performance:

Miles run	3,234
Passengers carried	1,106
Cost of operation—	
Wages of crew	$127.51
Gasoline (515 gals.)	$46.35
Lubricating oil	8.97
Total	$182.83
Cost of operation per mile	.06 cts.

FLUE WELDING FURNACE.

A new type of flue welding furnace, known as the "Kirkwood Down Flame," has recently been designed by Tate, Jones & Co., Inc., of Pittsburgh, Pa. The burner is applied to an extension combustion chamber, thus providing sufficient room for the complete combustion of the mixed oil and air; the products of combustion are conducted downward past the flue ends. Where the combustion chamber is below the flues the slag falling from



DOWN-FLAME FLUE WELDING FURNACE.

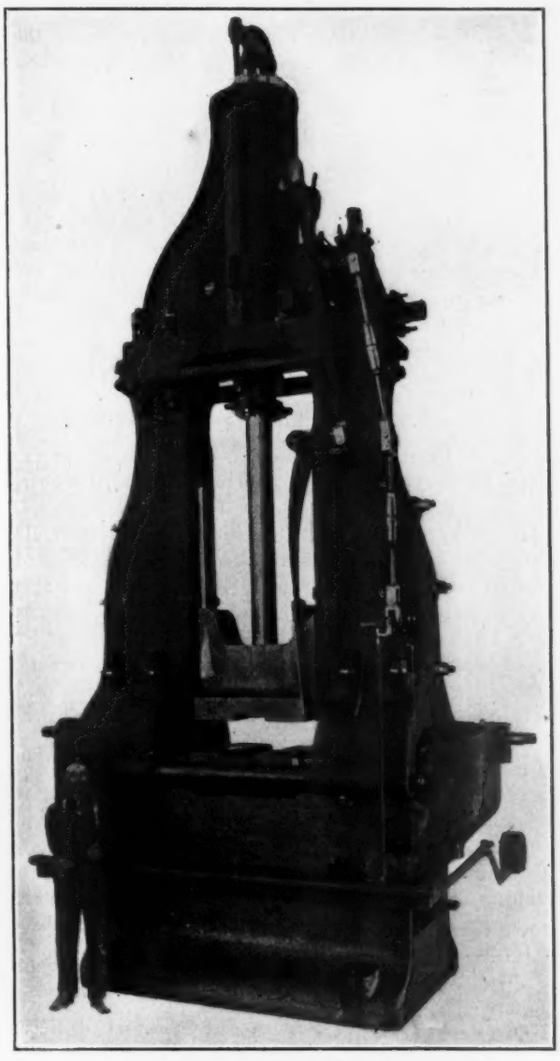
them cuts the brick lining of the chamber. This trouble is eliminated with the new furnace.

There is only one brick on each flue hole that ever requires renewing and it can be replaced by removing two bolts without disturbing the other parts of the furnace. The fire may be regulated by the operator without changing his position in front of the furnace. A cooling pipe is provided to blow the hot air away from him. Front guides and adjustable back stops are provided to suit the different lengths of tube.

STEAM DROP HAMMER.

Several important improvements have been made in the steam drop hammer manufactured by the Erie Foundry Company, of Erie, Pa. These, as well as the important features of the standard machine, are shown in the accompanying photograph of a 3,500-lb. hammer built for the Thomas B. Jeffrey Mfg. Co., manufacturers of the Rambler automobile. These hammers are rated on the actual weight of the falling parts, although the force of the blow is greatly increased, due to the fact that steam is taken above, as well as below, the piston. The anvil block of the 3,500-lb. hammer weighs 70,000 lbs., the total weight of the hammer being 98,000 lbs.

The frames are of semi-steel and overhang the anvil block the full width of the frame instead of only half the width, as formerly. The steel tie plate between the top of the frames and the cylinder base laps over the frames both on the inside and the outside.



3,500-LB. STEAM DROP HAMMER.

Steel taper wedges having a bearing the full length of the guides make it possible to take up wear, preventing breakage of the piston rod. A warning mark is placed on the guides which shows when the piston is near the bottom of the cylinder. Before the corresponding mark on the ram reaches this warning mark the anvil must be raised or a higher die used The ram, crosshead and sow block are made of open hearth steel forgings. Adjusting screws at the sides make it possible to move the hammer sidewise, enabling the operator to line up the dies quickly.

The spring piston stop placed at the top of the cylinder protects the cylinder head against careless handling and against damage from the rods breaking or pulling loose from the crosshead. If, in operating by hand, the lower port be left open too long, or if the rod should break, the piston flying upward will not break the cylinder or cylinder head, because, before reaching the head, its force will be absorbed by striking the projecting pin, causing all shock to be transmitted through the yoke to the side rods shown. The lower ends of these rods are keyed to lugs projecting from either side of the cylinder. In most cases the buffer spring will wholly absorb the blow. If not, the worst that can happen is the breaking of two easily replaced side rods.

These hammers are made in a large number of sizes varying from 600 lbs. capacity upward. The builders advise that it requires approximately one horse-power per 100 lbs. falling weight to operate a hammer and recommend a steam pressure of 80 to 100 lbs. at the hammer.

RAILWAY BUSINESS ASSOCIATION.

The Railway Business Association will hold its annual meeting at the Waldorf-Astoria Hotel, New York, on November 10, 1909. This will be a very important occasion, which it is proposed to conclude with a notable dinner having among the guests eminent leaders in the railroad, manufacturing, commercial and political worlds. If the association is to be made a permanent economic force, which many of those deeply interested in railway and allied interests have vigorously declared should be done, then there is need of a large representation of its membership and a full and careful consideration of the best means for enlarging its usefulness. The more people who are actively interested in its work, the greater will be its influence, and it is most desirable that if, in the opinion of any of its members, its plan and scope should be broadened or its methods changed, the annual meeting be made the place for consideration of all such matters, to the end that enthusiasm may prevail and all may feel that they are important factors in the movement.

The dinner will be attended by one of the most distinguished of gatherings, since the members of the Association, themselves an influential group of industrial captains, will have as their guests celebrated railroad officials, financiers, men of commerce and publicists. The dinner, moreover, will have a purpose—for the addresses of the national figures who are to speak will be a sort of symposium of assurances to the public that all concerned are earnestly seeking to promote permanent concord between the public and the railroads, and prosperity for both.

GOOD WORK OF SUMMERS' ORE CARS.—A new record was established in the loading of the steamer *Corey* at Two Harbors on Sunday, the 10th, when 10,111 gross tons of Pioneer ore from the Vermillion range was loaded in 39 minutes. Particulars of this record are not as yet at hand, but the time included all delays and probably embraced one shift of the steamer. The record in part was made possible by the use of the new Summers' steel ore cars, which dump their cargo in 45* seconds, as against 7½ minutes for the ordinary type of car. It is probable that all of the pockets were loaded and that the cars were standing on top of the pockets waiting to be dumped.—*Iron Trade Review.*

NEW YORK AND ST. LOUIS, 24 HOURS.—The Pennsylvania Railroad announces that beginning November 7 a 24-hour limited express train will be run between New York and St. Louis, leaving New York at 6:25 P. M., Eastern time, and St. Louis at 6 P. M., Central time. The apparent time will be 23 hours westward and 25 hours eastward. The distance from Jersey City to St. Louis by this line is about 1,052 miles which, after deducting the 15 minutes for crossing the river at New York, makes the rate through about 44.3 miles an hour. The best regular passenger time at present is 27½ hours.

* The drop doors on these cars were operated by hand. With the air operated doors, as described on page 369 of the October issue of the AMERICAN ENGINEER, the cars can be unloaded and the doors closed in about ten seconds on the average.

RAILROAD CLUBS.

Canadian Railway Club (Montreal).—On Tuesday evening, November 2nd, R. W. Burnett, master car builder of the Canadian Pacific Ry. at Montreal, will present a paper on "Maintenance Regulation Cards." Secretary, James Powell, P. O. Box 7, St. Lambert, Nr. Montreal, Can.

Central Railway Club (Buffalo, N. Y.).—At the meeting for November 12th, G. Herbert Condict, secretary of the International Lecture Institute, will read a paper on "The Application of Electricity to the Movement of Miscellaneous Terminal or Package Freight for Railway and Steamship Companies."

Secretary, Harry D. Vought, 95 Liberty street, New York City.

Iowa Railway Club (Des Moines, Ia.).—Next meeting, Friday, November 12th.

Secretary, W. B. Harrison, Union Station, Des Moines, Ia. Moines, Ia.

New England Railroad Club (Boston).—The next regular meeting will be held at Copley Square Hotel, November 9th.

Secretary, George H. Frazier, 10 Oliver street, Boston, Mass.

New York Railroad Club.—At the next regular meeting, Friday evening, November 19, H. McL. Harding, vice-president of the International Lecture Institute, 20 Broad street, New York City, will present a paper on "The Handling of Freight at Terminals."

Secretary, Harry D. Vought, 95 Liberty street, New York City.

Northern Railway Club (Duluth, Minn.).—At the meeting for November 27th, W. H. Hoyt, assistant chief engineer of the D., M. & N. Ry., Duluth, Minn., will speak on "Steel vs. Wooden Ties."

Secretary, C. L. Kennedy, 401 West Superior street, Duluth.

Railway Club of Pittsburgh.—A. Stucki will read a paper on side bearings at the November meeting, Friday, the twenty-sixth.

Secretary, C. W. Alleman, P. & L. E. R. R., Pittsburgh, Pa.

Richmond Railroad Club.—At the November meeting, which will be held on Monday, the 8th, the annual election of officers will take place and an entertainment be given for the ladies.

Secretary, F. O. Robinson, C. & O. Ry., Richmond, Va.

St. Louis Railroad Club.—At the meeting for Friday, November 12, T. E. Adams, superintendent of motive power of the St. Louis Southwestern Railway Co., will read a paper on "The Economical Consumption of Coal."

Secretary, B. W. Frauenthal, Union Station, St. Louis, Mo.

Southern & Southwestern Railway Club (Atlanta, Ga.).—The next regular meeting will be held November 18th at 10 A. M. The subjects to be discussed are "The Oil Lamp" and "Front End and Draft Arrangements." There will also be a general discussion on "How many million dollars per annum can American railroads save in damage to freight cars and contents by permitting switchmen to adopt passenger practice in handling equipment?"

Secretary, A. J. Merrill, 218 Prudential Building, Atlanta, Ga.

Western Railway Club (Chicago).—At the meeting of November 16th Col. B. W. Dunn, chief inspector of the Bureau for the Safe Transportation of Explosives, will read a paper on the "Transportation of Dangerous Articles."

Secretary, Jos. W. Taylor, 390 Old Colony Bldg., Chicago.

Western Canada Railway Club (Winnipeg, Man.).—Next meeting, Monday, November 8th.

Secretary, W. H. Rosevear, 199 Chestnut street, Winnipeg, Man.

NATIONAL MACHINE TOOL BUILDERS' CONVENTION

The eighth annual convention was held in New York City, October 12th and 13th. The committee on the standardization of machine tool motors presented a report of progress and was continued. The problem of the "creation of machinists" was discussed at length. Industrial education as embodied in the Cincinnati continuation school and the Fitchburg high school was also discussed.

The following officers were elected for the ensuing year: F. A. Geier, Cincinnati Milling Machine Company, Cincinnati, Ohio, was chosen president. Fred L. Eberhardt, Gould & Eberhardt, Newark, N. J., the retiring president, was elected first vice-president; P. E. Montanus, Springfield Machine Tool Company, Springfield, Ohio, the retiring secretary, was elected second vice-president. C. Hildreth, Whitcomb-Blaisdell Machine Tool Company, Worcester, Mass., was chosen secretary, and George W. Fifield, Lowell, Mass., was elected treasurer.

The spring meeting will be held in Rochester, N. Y.

TECHNICAL PUBLICITY ASSOCIATION.—The first of the monthly meetings for 1909-10 was held Thursday evening, October 14th, in the headquarters, 14 Gramercy Park, New York. There was a good attendance. All enjoyed the informal dinner and an interesting programme. The president of the association, Charles S. Redfield, advertising manager of the Yale and Towne Manufacturing Company, was toastmaster. The only extended address was that of George French, editor of *Advertising and Selling.* Preceding his remarks the attention of the members was occupied with reports of committees. The chairmen who were called upon outlined the work to be done during the winter months. Howard M. Post, advertising manager of the Western Electric Company, told of plans for a systematic, analytical study of effectually tracing results from trade paper advertising. The keying method has proved inadequate. There should be some way of determining the effect of such advertising. At the conclusion of a discussion of this subject in which every point of view was presented, Mr. Post was made chairman of a committee to outline this study work for the association.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—D. B. Sebastian, secretary of the association, advises that the second annual meeting will be held in Chicago some time during the month of May, 1910. Mr. Sebastian may be addressed at 327 La Salle Station, Chicago, Ill.

INTER-STATE COMMERCE COMMISSION NEEDS EXAMINERS AND CLERKS.—The United States Civil Service Commission announces an examination on November 23-24, 1909, to secure eligibles from which to make certifications for the appointment of examiners and clerks in the Bureau of Statistics and Accounts, Inter-State Commerce Commission. The eligibles obtained from this examination will be classified in three general groups with salaries ranging as follows: Group A—Examiners, $2,220 to $3,000; Group B—Examiners, $1,860 to $2,100; Group C—Clerks, $1,200 to $1,620.

If a sufficient number of high-grade eligibles is obtained, it is

expected that there will be appointed approximately five from Group A, fifty from Group B, and fifty from Group C. For positions in Groups A and B it is desired to obtain men having special qualifications for work in the following fields of railway and other common-carrier accounting: 1.—Steam roads: General Auditing, Disbursements, Freight, Passenger, Claims. 2—Electric Railways; 3—Express Service; 4—Steamship Service; 5—Other common-carrier service. Applicants should at once apply to the United States Civil Service Commission, Washington, D. C., for application Form 304.

BOOK NOTE.

Lighting Engineers' Hand Book. Compiled by L. R. Pomeroy. 231 pages. 4 x 7 in. Leather bound. Price, $1.00. Published by the Safety Car Heating & Lighting Co., 2 Rector street, New York City.

While the book is a "lighting engineers' handbook," as designated by its title, it really covers a much broader field. In the April number of this journal was published a study of the number and kind of machine tools required in a railway locomotive machine and boiler shop, prepared by Mr. Pomeroy. The editors received a number of letters congratulating them upon presenting this study and the following extract is taken from one of them: "Hope you can draw still further on Mr. Pomeroy's remarkable store of information. I have felt for many years that I would like to be his stationer for his note book trade alone." The data for the handbook has been carefully selected by Mr. Pomeroy from his "valuable store of information" and, like all of his notes, is arranged in a compact form, so that it can conveniently be found and in a form for ready application. It is unique from the fact that most of the information contained in it does not appear in other handbooks, or if it does, is not arranged in nearly as convenient a form. The book is made up of eight sections as follows: General, 41 pages; electricity, 22 pages; lighting, 63 pages; steam, 19 pages, heat and heating, 15 pages; traction, 17 pages; pipes and tubes, 26 pages; hydraulics, 9 pages.

It is difficult to review a book of this kind and give the reader any adequate idea of what it contains, or of its scope. To give some idea of the value of the book, however, it might be said that the general section, instead of containing a lot of simple miscellaneous information, which the engineer always keeps within easy reach, contains only a very small amount of such material and this very compactly arranged. The greater part of this section is given over to such information as the strength of gear teeth; formula for coiled springs; emery wheel speeds; data concerning U. S. standard bolts and nuts; the loading of rope; belting; crane data; horse-power of shafting; power consumed by blowers; amortization; efficiency; geometrical progression for spindle speeds and a very extensive and complete discussion of the power requirements for railroad shop tools. The sections on lighting and heating are specially complete, going into the matter thoroughly. In connection with the chapter on lighting, passenger car lighting, including the axle lighting system, is fully considered, as is also the use of storage batteries in this connection. In addition to the general information contained in the chapter on heat and heating, a brief description is given of the Thermo Jet system of car heating. This book should be not only in the hands of all those who are specially interested in the subject of car lighting and heating, but will be found of great value for engineers generally, and particularly to those interested in railroad work.

PERSONALS.

T. O. Moore has been appointed master car builder of the Texas State Railroad.

M. G. Brown has been appointed master mechanic of the Gulf & Ship Island, with office at Gulfport, Miss.

George H. Smeltzer has been appointed superintendent of the locomotive and car shops of the Philadelphia & Reading at Reading, Pa.

William Wibel has been appointed acting assistant purchasing agent of the National Railways of Mexico, with office at New York.

Ben Johnson has been appointed assistant locomotive superintendent of the United Railways of Havana, with office at Havana, Cuba.

C. J. Kennedy has been appointed master mechanic of the Denver, Boulder & Western, with office at Boulder, Colo.

T. J. McPherson has been appointed master mechanic of the Peoria & Pekin Union, with office at Peoria, Ill.

W. M. Perrine has been appointed master mechanic of the New Jersey Central and Lehigh & Susquehanna divisions of the Central Railroad of New Jersey.

E. E. Bashford, assistant purchasing agent of the National Railways of Mexico at New York, has resigned to accept promotion in another department.

J. J. Connor has been appointed acting general foreman of the Houston & Texas Central, with office at Ennis, Tex., succeeding J. F. Murphy, deceased.

W. J. O'Neill, formerly general foreman for the Chicago, Rock Island & Gulf, at Shawnee, Okla., has been appointed master mechanic at Fort Worth, Texas.

C. M. Bailey has been appointed master mechanic of the Chicago, Burlington & Quincy Railroad-Lines West of the Missouri River, with headquarters at Wymore, Neb.

H. H. Hale, formerly master mechanic of the Gulf & Ship Island R. R., has been appointed master mechanic of the Cincinnati, Hamilton & Dayton, with office at Lima, Ohio.

C. J. Cooper, master mechanic of the Toledo & Ohio Central has resigned. He will go to Japan to become American mechanical instructor in the Kumamota Higher College of Technology.

C. H. Kelly, for 10 years connected with the store department of the Delaware, Lackawanna & Western, has been appointed assistant to the general storekeeper of the Lehigh Valley at Packerton, Pa.

G. E. Johnson, formerly master mechanic of the Wymore division, has been appointed general master mechanic of the Chicago, Burlington & Quincy Railroad-Lines West of the Missouri River, with headquarters at Lincoln, Neb.

C. M. Hoffman, master mechanic for the St. Louis & Louisville division of the Southern Ry. at Princeton, Ind., has tendered his resignation to take effect October 1. He will take a position with a western railroad.

M. J. Collins, assistant general purchasing agent of the Atchison, Topeka & Santa Fe at Chicago, has been appointed general purchasing agent, with office at Chicago, succeeding W. E. Hodges, elected vice-president.

Daniel H. Deeter has been appointed general master mechanic of the Philadelphia & Reading, with headquarters at Reading,

Pa. All division master mechanics and the general locomotive inspector and the general boiler inspector will report to him.

W. G. Jones, general car foreman of repairs of the St. Louis-Louisville lines of the Southern Railway at Princeton, Ind., has been appointed general foreman of the car department of the St. Louis, Brownsville & Mexico, with office at Kingsville, Tex.

G. N. Howson, master mechanic of the Southern Railway at Alexandria, Va., has been transferred to Princeton, Ind., succeeding C. M. Hoffman, resigned. E. C. Sasser, master mechanic at Charleston, S. C., succeeds Mr. Howson and C. H. Kadie succeeds Mr. Sasser.

P. Maher, superintendent of motive power and equipment of the Toledo, St. Louis & Western and the Chicago & Alton at Bloomington, Ill., has been appointed also superintendent of motive power and equipment of the Minneapolis & St. Louis and the Iowa Central.

William McIntosh, superintendent of motive power of the Central of New Jersey at Jersey City, N. J., having been granted leave of absence; his duties will be assumed by C. E. Chambers, general master mechanic at Jersey City, who is appointed acting superintendent of motive power, with office at Jersey City.

F. W. Mahl, general mechanical engineer and purchasing agent of the Colorado & Southern at Denver, Colo., has been appointed assistant to the director of maintenance and operation of the Harriman Lines, in particular charge of questions relating to shop practice, equipment and motive power, with office at Chicago.

Dr. Chas. P. Dudley, of Altoona, Pa., consulting chemist of the Pennsylvania Railroad, and president of the American Society for Testing Materials, was elected president of the International Society for Testing Materials at the congress held in Copenhagen, September 7 to 11. The next congress will be held in this country in 1912, in accordance with the invitation extended by the American Society.

P. J. Colligan, assistant master mechanic of the Chicago, Rock Island & Gulf at Fort Worth, Tex., has been promoted to division master mechanic at Dalhart, with jurisdiction over three branches of the Rock Island system. He will be in charge of the Mexico and Amarillo divisions of the Chicago, Rock Island & Pacific; the El Paso division of the Chicago, Rock Island & El Paso and the Amarillo division of the Chicago, Rock Island & Gulf.

H. H. Stoek, for many years editor of *Mines and Minerals,* has been appointed professor of mining engineering at the University of Illinois. Prof. Stoek has had a very wide and extensive experience which fits him admirably for his new work. This announcement is made under the authority of Dean Goss and it is to be accepted as evidence that the new department of mining engineering of the University of Illinois is to be as efficiently manned as are its other departments of engineering.

CATALOGS

PANEL BOARDS.—Bulletin No. 4681, recently issued by the General Electric Company, ilustrates and lists all of the panel boards designed by them.

"WHAT WE MAKE."—The B. F. Sturtevant Company, Hyde Park, Mass., has ready for distribution a new general catalog, No. 165, showing its complete line of fans, blowers, dust collecting and conveying systems, fuel economizers, engines, motors, turbines, etc. Principal dimensions and other useful information are given.

FOUNDRY FACINGS.—A twelve-page booklet of envelope size has been issued by the Joseph Dixon Crucible Company, Jersey City, N. J., describing their facings for various kinds of work. It contains some general information in brief on the proper use of facings, values of different kinds, and working conditions met in foundry practice.

MACHINE TOOLS.—The sixty or more bulletins issued by The Hamilton Machine Tool Company, Hamilton, Ohio, have been assembled and are being distributed in the form of a catalog. The different lines of tools including lathes, planers, shapers and upright and radial drills are illustrated and very fully described; the more important features and special attachments are considered in detail.

ELECTRIC APPARATUS.—Among the recent bulletins issued by the General Electric Company, of Schenectady, N. Y., are the following: No. 4699, motor driven air compressors of the geared type for use in connection with the air brake on electric cars; No. 4687, direct current motor-starting rheostats; No. 4676, multiple enclosed arc lights; No. 4760, G. E. switchboard instruments, type R2; No. 4691, small polyphase motors for use in connection with motor drives on the smaller machine tools.

GASOLINE ENGINES.—Catalog 80 D from Fairbanks, Morse & Co., Wabash avenue and Eldredge Place, Chicago, Ill., describes their small engines having a capacity of from 1 to 12 h. p. It opens with an illustrated description of these engines, considering the general construction and the operation, and also describes each part in detail. The remainder of the catalog considers the different types and applications, and presents much valuable information for those who have need of such power. The new 1 h. p. engine "Jack Junior" is also described for the first time. It is a practical, durable, 4-cycle engine, water-cooled, and made to meet the demand for a small reliable engine for running light machinery.

NOTES

EHRET MAGNESIA MFG. CO.—Henry L. Leach has become identified, as railroad representative, with this company, whose headquarters are in the Land Title Bldg., Philadelphia, Pa.

THE WARNER & SWASEY COMPANY.—This company, of Cleveland, Ohio, is building a large addition to its new plant to be completed by December 1st. The buildings are of single-story, steel and concrete construction, and equipped with electric cranes and other modern features.

FURNACES.—The furnaces for forging, heating and welding purposes, manufactured by the Rockwell Furnace Company, 26 Cortlandt street, New York, are illustrated and described in a 40-page catalog, 9 by 12 inches in size. Several pages are given over to a description of the attachments and apparatus used in connection with the furnaces.

DEARBORN DRUG & CHEMICAL WORKS.—Edward C. Brown, manager of this company in the Hawaiian Islands and the Orient, has been elected president of the Commercial Club of Honolulu. Mr. and Mrs. Brown recently made a trip in the interests of the Dearborn Company to the Orient, spending several months in China, Japan, Korea, and the Philippines.

THE B. F. GOODRICH COMPANY.—This company has just finished, in New York City, one of the most admirably equipped buildings for the handling of their rubber products, especially tires, that there is in America. It is at Broadway and West Fifty-seventh street and has twelve floors and a basement. The latter is used entirely for the storage of automobile tires. Throughout this building no mechanical device for the ready handling of the heavy stock has been omitted.

THE GENERAL ELECTRIC COMPANY reports that the sales of Tantalum lamps are more than double what they were a year ago and the lamp appears to be sharing with the demand for high efficiency lamps created by the introduction of Tungsten lamps. The Tantalum lamp, as at present supplied is giving most excellent life service. Contrary to general belief, these lamps will give good commercial life on alternating current of 60 cycles or less. Their life on this frequency will average well above 600 hours.

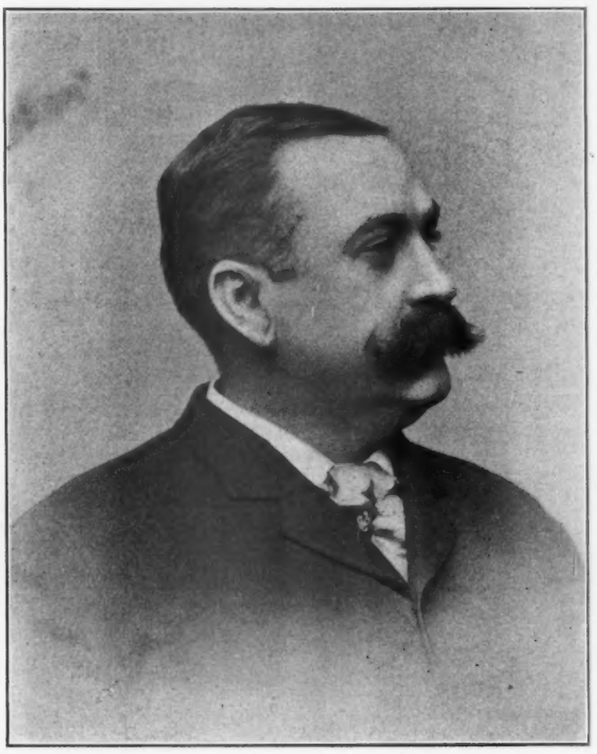
L. M. BOOTH COMPANY.—W. R. Toppan, vice-president and general manager, has closed a contract with the Vandalia Railroad Company for a Booth water softener having a treating capacity of 40,000 gallons per hour, and a 350,000 gallon steel storage tank to be installed in connection with the new shops at Terre Haute, Indiana. The Booth water softener now under construction upon the C. R. I. & P. Ry., at Sayre, Okla., will be placed in operation shortly. The simplicity and convenience of operation of the Booth Company Type "F" softener called forth very favorable comment at the Master Mechanics' convention this year.

THE PILLIOD COMPANY.—This company is erecting an additional factory, 180 x 50 ft., at Swanton, Ohio. It is expected that this will be completed and $20,000 worth of new machinery will be installed by December first. It will then be possible to turn out five complete gears per day. Within the past two weeks orders have been received for the Baker-Pilliod valve gear for four consolidation locomotives for the Mexican Railroad, two 10-wheel engines for the Missouri & North Arkansas Railroad, five Mallet for the Norfolk & Western Railroad, fifteen 10-wheel passenger engines for the Seaboard Air Line and six switch engines for the Central Railroad of New Jersey.

ROBERT M. VAN ARSDALE

Robert Morris Van Arsdale, proprietor and sole owner of this journal, died very suddenly of apoplexy at his home, 276 W. 71st street, on the evening of November 23.

He was born in Titusville, Mercer Co., New Jersey, on July 1, 1848, and was connected with trade journalism from his twenty-fifth year, and at his death was one of the very few successful individual publishers. His first work was with a commercial paper in Chicago, which, however, did not prove congenial, and two years later, in 1875, he joined the staff of the *Railroad Gazette* as an advertising solicitor. His personal qualifications and business ability made him remarkably successful in this position.



He remained with the *Gazette* for about six years, and on January 1, 1880, purchased the *National Car Builder,* which was being published by Vose, Dinsmore & Co., New York. This paper was what would now be known as a house organ, and was immediately made independent and greatly broadened by its new owner and by James Gillet, who remained with it as editor. Its influence in car matters soon became national, and it was continued with marked success until January, 1896, when Mr. Van Arsdale purchased the *American Engineer & Railroad Journal* from M. N. Forney and combined the two papers under the title of AMERICAN ENGINEER, CAR BUILDER AND RAILROAD JOURNAL. This title was retained for two years, and was then changed to its present form, THE AMERICAN ENGINEER AND RAILROAD JOURNAL.

In purchasing this publication, Mr. Van Arsdale became the sole owner of the oldest railroad paper in the world, which had been founded in 1832 and published continuously since that date. Under Mr. Forney's ownership it had obtained a commanding position as a motive power authority and the combination of it with the *National Car Builder,* of equal reputation in the car department, made a remarkably powerful and influential publication. Mr. Van Arsdale, however, was not satisfied, and proceeded to develop, broaden and increase the influence of the combination along conservative lines, which policy was vigorously pursued up to the time of his death.

Upon the retirement of Mr. Forney at the end of 1896 George M. Basford was secured as the editor, and during the next nine years Mr. Van Arsdale's policy of publishing a paper which should not only be the champion of the motive power department and a leader in its development, but also of the greatest possible practical benefit to its individual subscribers, was fully developed and most successfully put into effect.

An illustration of his interest in the progress of the motive power department on American railways is shown in the elaborate series of tests on locomotive front end appliances, which were undertaken and most generously provided for by him. These tests were made at the locomotive laboratory at Purdue University under the direction of a committee of the Master Mechanics' Association, which was not then in a financial condition to undertake them itself, and the results obtained were of great importance. This action on the part of a publisher was widely commented upon and most generously praised throughout the country. The tests covered a period of two years.

Mr. Van Arsdale's success as a publisher was greatly assisted by his wide acquaintance and the esteem with which he was held by all who knew him. It was a valuable acquaintance, because it was special, being among railroad mechanical officials and manufacturers of railway supplies, and including nearly all of them. It has been commonly stated that Mr. Van Arsdale had no enemies, and this must have been very nearly true. He was equitable, contented and always serene. The use

to which he put the first large sum of money which he was able to save through frugality and hard work was characteristic of his nature; he used it to buy a city house in Chicago for his mother, who had always wanted a house in the city.

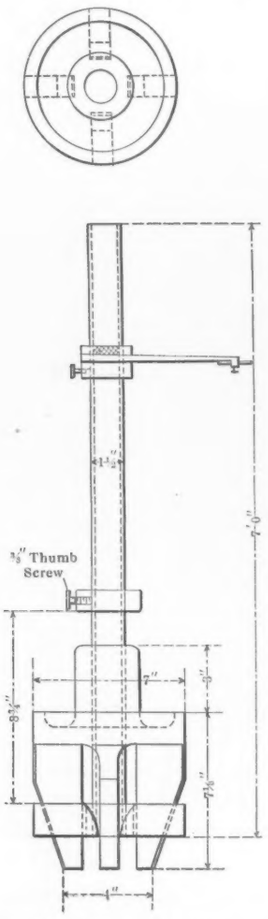
One of the most prominent impressions obtained of him by his business associates was his very high ideas of honor and his unusually strict business integrity. His honesty, both in word and action, was proverbial among his friends and associates. He was noted for his jovial nature and his manner of greeting his friends will always be remembered by those who knew him well. He was an excellent example of the finest type of good citizen who quietly does his work with few public appearances and nevertheless leaves a name which will be remembered by the very large number whom he helped along. His share of the public duty was always performed with pleasure, no matter what form it took. He sat on the Grand Jury in New York every year for many years.

His activity in organizing and assisting, both through the columns of his paper and by personal effort, any association which was designed to improve the work of the mechanical department of the railways was well known. He was a charter member of the New York Railroad Club and attended the conventions of the Master Mechanics' and Master Car Builders' Associations every year for over twenty years. He was a member of the American Trade Press Association of New York.

Mr. Van Arsdale was a very active member of the First Church of Christ, Scientist, in New York City, and of the Mother Church in Boston. He was formerly a member of the Manhattan and Colonial Clubs of New York. He is survived by his widow. Interment took place in Chicago on November 28.

STACK CENTERING BAR.

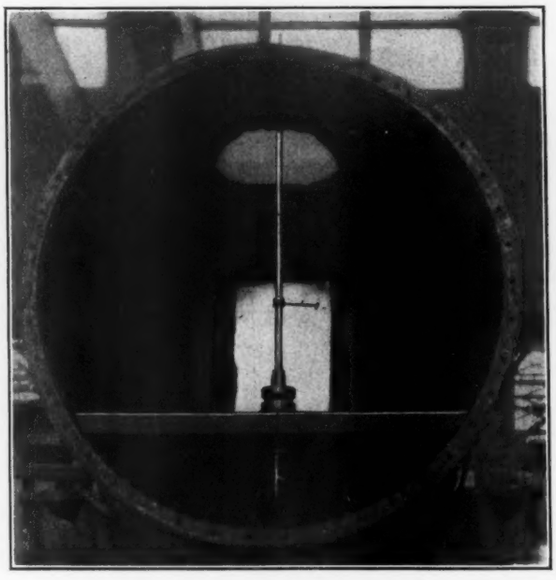
A very convenient apparatus for quickly and accurately centering the stack of a locomotive over the exhaust nozzle is shown in the accompanying illustrations. This device was designed and is in use at the Collinwood shops of the Lake Shore & Michigan



DETAILS OF CENTERING BAR.

Southern Railroad and consists of a long bar mounted on a base fitted with beveled jaws and a sliding ring so that it automatically centers itself in the exhaust nozzle tip and simply needs to be set into place to be assured of an accurate location. On the bar is a swinging arm, which can be located at any point, by means of which the stack, after being set into place, can be accurately centered, both at the choke and top.

NEW STEAM-ELECTRIC LOCOMOTIVE.—A locomotive of an entirely new type, the driving mechanism of which consists of a steam turbine coupled to an electric generator which supplies current to four motors on the driving axles, is under construction by the North British Locomotive Co., of Glasgow, Scotland. This new type of motive power, which is called the Reid-Ramsay system, was described by Hugh Reid, deputy chairman and chief managing director of the company above mentioned, in his inaugural address as honorary president of the Glasgow University Engineering Society, October 29. It was explained that this is not the first attempt to develop a self-contained



STACK CENTERING BAR IN PLACE.

steam-electric unit. The Heilmann steam-electric locomotive, built in 1894, was given wide publicity at that time; but the Reid-Ramsay locomotive, it is stated, develops the idea on a different and more practical basis. In the new engine, steam is generated in a boiler of the ordinary locomotive type, which is fitted with a superheater. The steam from the boiler is led to a turbine of the impulse type, running at a speed of 3,000 revolutions per minute, to which is directly coupled a direct-current, variable-voltage generator. The generator supplies electrical energy at from 200 to 600 volts to four series-wound railway motors, the armatures of which are built on the four main or driving axles of the locomotive. The exhaust steam from the turbine passes into an ejector condenser, and together with the circulating condensing water, is delivered eventually to the hot well.

FOUR-CYLINDER SIMPLE LOCOMOTIVE WITH SUPERHEATER

CHICAGO, ROCK ISLAND & PACIFIC RAILWAY.

Two locomotives, each with four 17½x26 inch cylinders and using highly superheated steam at 160 pounds' pressure, have recently been delivered to the Chicago, Rock Island & Pacific Railway by the American Locomotive Company. While these are not the first four-cylinder simple locomotives to be built in this country, they are the first of that arrangement to use superheated steam and the first to be built for regular service. In Great Britain, however, as our readers are aware, four simple cylinders have been employed for passenger locomotives using both saturated and superheated steam for several years.

Reduction of severe blows to the track at high speed, more constant turning moment with a higher average tractive effort. reduction of distorting strains in the engine frames, lighter rods, crossheads, pistons, etc., small and light piston valves, reduction of boiler troubles, and a steady even exhaust with larger nozzle, are some of the more prominent advantages of a design of this kind for passenger service. The most important disadvantages are:— The cranked axle, greater number of parts, difficulty of inspection, complex lubricating arrangement and expense of construction and maintenance.

It is interesting to note that the design has been taken up with a view to experiment after an experience by this company, extending over four or five years, with balanced compound and simple two-cylinder Atlantic type locomotives of practically the same weight and power both with and without superheaters.

As will be seen from the accompanying illustration, the engines present a very attractive appearance, the lines of the design being symmetrical and pleasing. In working order they have a total weight of 202,000 pounds, of which 116,000 pounds is carried on the driving wheels. This is an increase of 14,000 pounds over the weight on driving wheels of the road's standard design of two-cylinder Atlantic type engine, this increase being permissible because of the balancing of the reciprocating parts and the elimination of the hammer blow.

In the arrangement of cylinders, the design follows the Von Borries and Vauclain balanced compound locomotive, the four cylinders being set in the same transverse and horizontal planes.

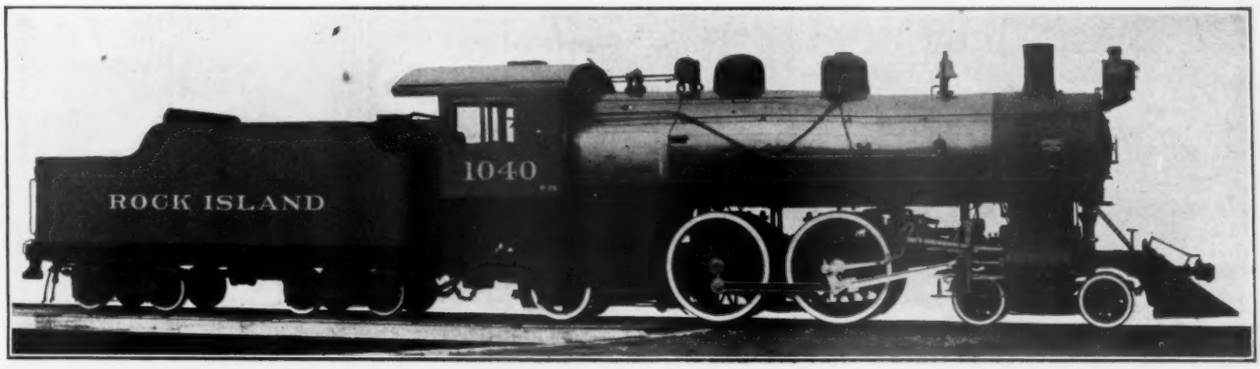
The cylinder casting is made in two parts with half saddles, each part containing an inside and outside cylinder and a valve chamber placed above and between them. Each cylinder is 17½ inches in diameter by 26 inches in stroke. All four cylinders drive on the front pair of driving wheels, the main rods of the two outside cylinders being connected to crank pins on the wheels in the usual manner and the inside cylinders to the cranked axle. This axle is a solid forging and of an exceedingly strong construction to stand all the strains to which it is subjected. The bearings are 11 inches in diameter throughout, and the driving box journal and journal for the back end of the main rod of the inside cylinder are connected by a circular disk 4¼ inches wide. The crank pins are connected by a rectangular section 10½ inches by 13 inches, the whole forming a very durable arrangement likely to wear well in service.

Because of the connection being on the front axle it was necessary, in order to obtain a good length of main rod, to locate the cylinders about 3 feet further ahead than usual in this type of engine, the distance between the centre of the cylinders and that of the front driving axle being 11 feet. This permits the use of an 84-inch main rod.

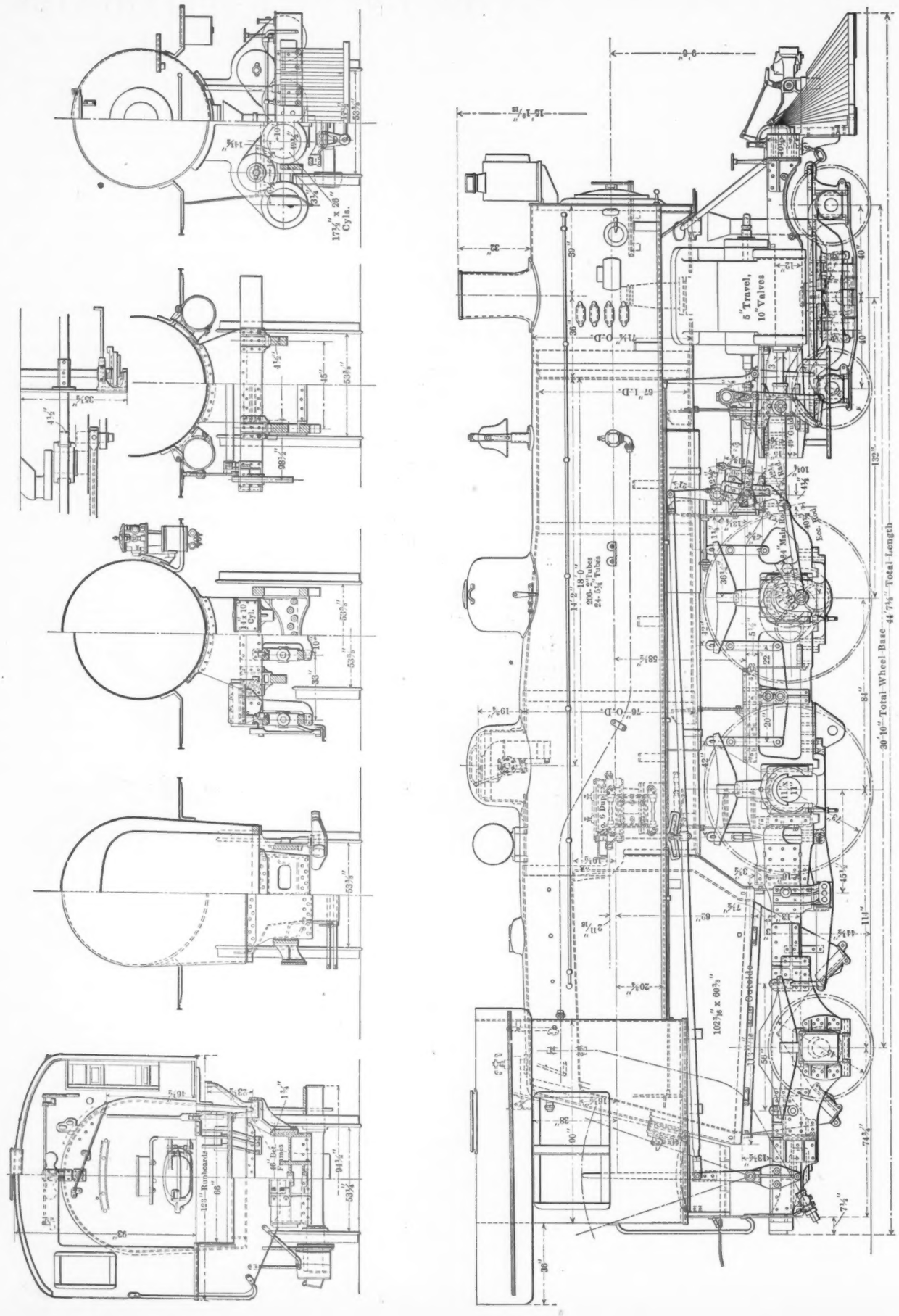
Increasing the normal distance between the front drivers and the cylinder center 3 feet involved, of course, an increase of a like amount in the length of the boiler; though, in this instance, this was accomplished with an increase of only 2 feet in the length of the tubes.

A very simple valve motion, involving no complications in the cylinder construction, has been employed. Superheated steam is distributed to the inside and outside cylinders on each side by two 10-inch hollow piston valves carried on a single stem and actuated by the Walschaert valve gear. Both valves have inside admission and outside exhaust. The live steam passage branches at a short distance down from its connection with the steam pipe and one part leads to the center of each valve. The front valve controls the admission of steam to the forward ports of the two cylinders, while the rear valve serves their back ports, the inside ends of the two valves operating the outside cylinder. This results in such an arrangement that while, as mentioned above each valve has inside admission, in combination they make what is the same as an outside admission valve for the outside cylinder and an inside admission valve for the inside cylinder. As the valve gear is connected to the cross-head of the outside cylinder, it is accordingly arranged for an outside admission valve. The piston valve, which is of special design for use with superheated steam, is shown in one of the accompanying illustrations.

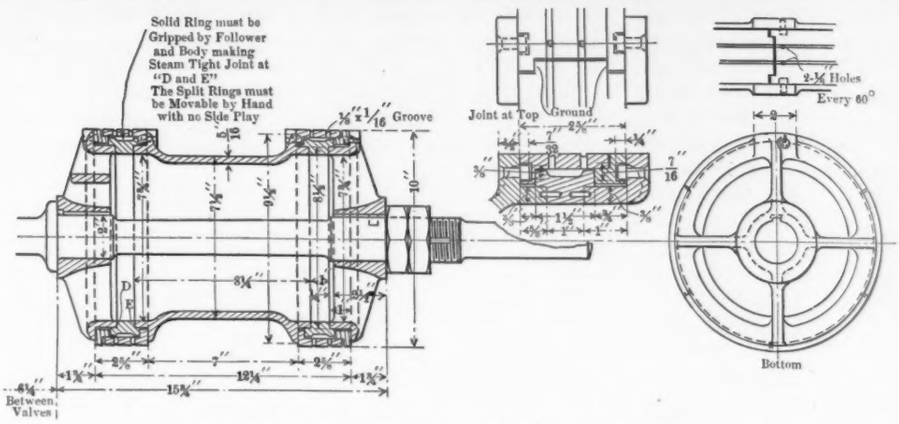
The arrangement of the Walschaert valve gear is worthy of special notice as representing a very simple, compact and satisfactory design of this type of gear. The link is carried in a



BALANCED SIMPLE ATLANTIC TYPE LOCOMOTIVE WITH SUPERHEATER—CHICAGO, ROCK ISLAND AND PACIFIC RY.



GENERAL ELEVATIONS AND SECTIONS OF FOUR CYLINDER, BALANCED SIMPLE, ATLANTIC TYPE LOCOMOTIVE WITH COLE SIDEHEAD SUPERHEATER.—C., R. I. & P. RY.


Solid Ring must be Gripped by Follower and Body making Steam Tight Joint at "D and E"
The Split Rings must be Movable by Hand with no Side Play
1/8" x 1/16" Groove
Joint at Top Ground
2-1/4 Holes Every 60°
Bottom
Between Valves

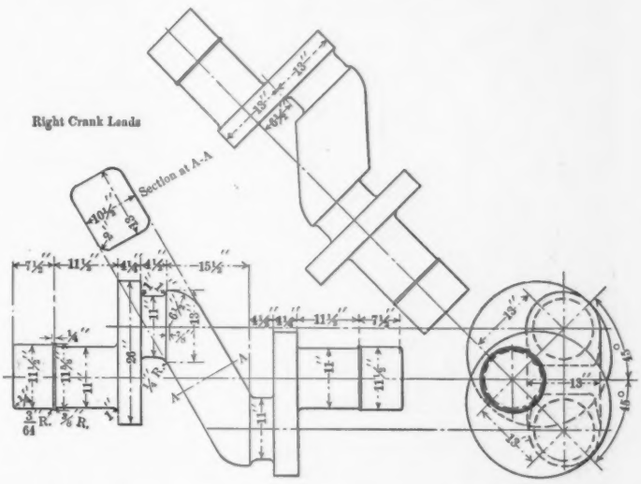
DETAILS OF ONE VALVE—TWO LIKE THIS ON EACH STEM.

cast steel bracket bolted to the front of a yoke or cross-tie located a little ahead of the front driving wheels. A longitudinal bearer extending between this cross-tie and the guide yoke furnishes support for the bearings of the reverse shaft, the forward extending arm of which is connected by means of a link to the radius bar 9¾ inches ahead of the link block. The front end of the radius bar has a pin connection to the combination lever, the upper end of which has a similar connection to the downward extending arm of the rocker which transmits the motion to the valve and is carried in a bearing secured to the guide yoke. The inside arm of the rocker transmits the motion to the valve rod by means of a block which works in a yoke in the rod arranged very similar to the Canadian Pacific design.* The rear end of the valve rod is extended and slides in a guide bolted to the back of the yoke. It will be noticed that the upper end of the combination lever is offset ⅝ of an inch. This was necessary in order to neutralize the effect on the valve events of the angularity of the main rods; and to give as nearly equal cut-offs as it is possible to obtain in two cylinders connected at 180 degrees to each other and operated by two valves deriving their motion from a single valve gear.

The frames consist of a main frame of cast steel 4½ inches wide with a single front rail 3¼ inches in width cast integral with it, and a slabbed rear section spliced to the main frame just back of the rear driving wheel. There is also an outside supplementary frame which carries the trailing journal box and is connected to the inside frame through the medium of heavy steel spacing castings.

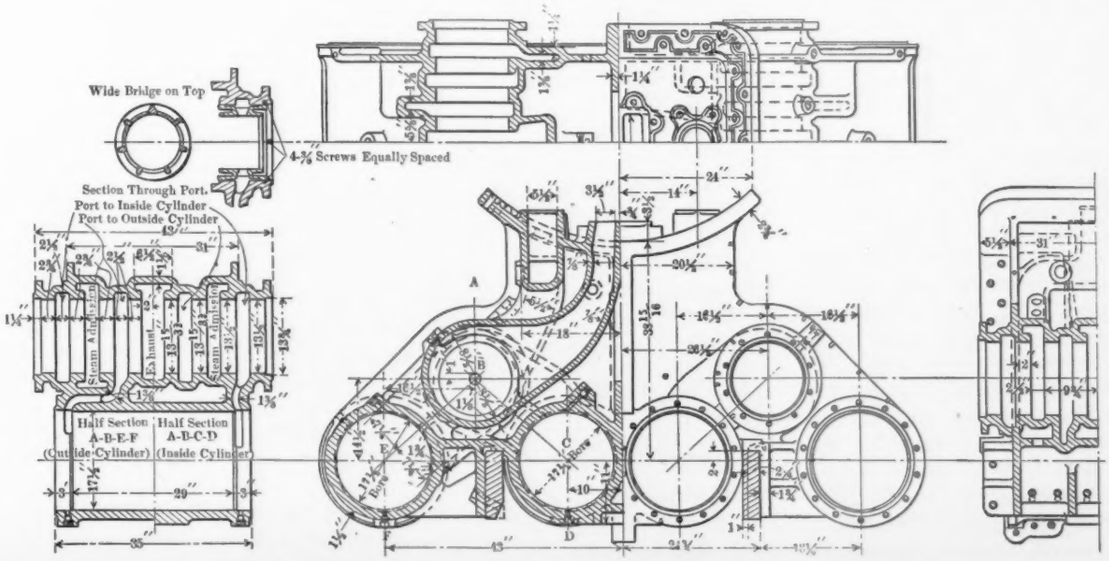
An unusually strong and substantial system of frame bracing has been employed. This includes, in addition to the cast steel foot plate at the rear of the engine, a cross-tie between the frames just ahead of the front of the firebox; another back of the rear pedestals; one, having a bearing of 41½ inches on the upper rails of the frames, between the front and rear driving wheels and one spanning the lower rails of the frames immediately back of the forward pedestals, all of these being of cast steel. The frames are further braced together by the cross-tie ahead of the front driving wheels, which furnished the support to the link bracket, and by the heavy guide yoke. The boiler is secured to the frames at all of these points by steel plates.

The boiler is of the radial stayed extended wagon top type with sloping back, head and throat sheet. The barrel measures 68⅛ inches outside diameter at the front ring. It contains 206 2-inch tubes and 24 tubes 5¼ inches ouside diameter, which contain the superheater pipes. The tubes are 18 feet long. The boiler has a total evaporative heating surface of 2726 square feet, of which the tubes contribute 2551 square feet and the fire-



CRANK AXLE, ROCK ISLAND BALANCED SIMPLE LOCOMOTIVE.

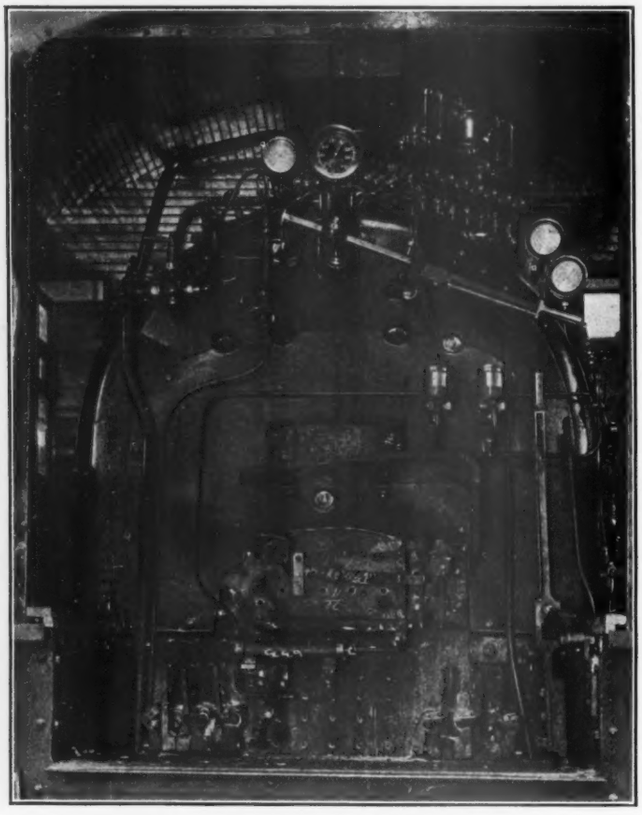
* See AMERICAN ENGINEER, January, 1908, page 16, and November, 1909, page 430.



DETAILS OF CYLINDER CASTING—ROCK ISLAND BALANCED SIMPLE LOCOMOTIVE.

box the remainder. The firebox is 102 3/16 inches long and 60⅜ inches wide and provides a grate area of 42.8 square feet.

Outside of the superheater, the boiler presents no unusual features of construction. The superheater is the builder's latest design of the fire tube type with side headers, similar to the arrangement applied to a consolidation engine built for the Wabash Pittsburgh Terminal Railway,* except that it is designed to give a higher degree of superheat. In the design here applied, each 5¼ inch tube contains four 1¼ inch superheating tubes arranged in double pairs and connected at the ends by return bends. The inside members of the two pairs are formed of a single tube which is looped at the front end, thus compelling the steam to traverse four times the length of the tubes in its passage from the dry pipe to the cylinders. This arrangement not only gives as high a degree of superheat as it is practicable to obtain, but also reduces the number of steam joints to inspect and maintain to a minimum. The ends of the



VIEW IN CAB—ROCK ISLAND BALANCED SIMPLE LOCOMOTIVE.

superheating pipes are bent around horizontally with a large radius to meet the side headers. In this way complete freedom for the expansion and contraction of the superheater tubes due to variations in temperature is provided. The inlet and outlet pipes of each four-tube superheater element are connected by a gland and secured to their connections with the header by a single bolt passing through the header with the nut and thread on the outside. Access is given to these bolts from the outside by means of covered openings in the side of the smoke box.

A damper automatically operated by a steam cylinder connected to the steam chest controls the passage of gases through the 5¼-inch tubes and around the superheating pipes.

The cylinders and valves are lubricated by a Nathan seven sight-feed lubricator and Campbell graphite cups are also provided for the cylinders.

Careful attention was given to the location of the various fittings on the boiler back head with the result that a very handy cab arrangement was effected, as will be seen from the illustration of the inside of the cab.

* For full drawing and description, see AMERICAN ENGINEER, June, 1909, page 256.

The tender is equipped with a water bottom tank, having a capacity of 7,500 gallons and space for 13 tons of coal. The tank is mounted on a solid cast steel tender frame manufactured by the Commonwealth Steel Company. The tender trucks are of the four-wheel equalized pedestal type with cast steel bolster.

The general dimensions, weights and ratios of these locomotives are as follows:—

GENERAL DATA.

Type	4-4-2
Gauge	4 ft. 8½ in.
Service	Passenger
Fuel	Bit. Coal
Tractive effort	29,600 lbs.
Weight in working order	202,000 lbs.
Weight on drivers	116,000 lbs.
Weight on leading truck	49,000 lbs.
Weight on trailing truck	37,000 lbs.
Weight of engine and tender in working order	351,900 lbs.
Wheel base, driving	7 ft.
Wheel base, total	30 ft. 10 in.
Wheel base, engine and tender	62 ft. 8½ in.

RATIOS.

Weight on drivers ÷ tractive effort	3.92
Total weight ÷ tractive effort	6.80
Tractive effort × diam. drivers ÷ heating surface	793.00
Tractive effort × diam. drivers ÷ equiv. heating surface	648.00
Total heating surface ÷ grate area	63.90
Equiv. heating surface ÷ grate area	78.00
Firebox heating surface ÷ total heating surface, per cent	6.42
Weight on drivers ÷ total heating surface	42.50
Weight on drivers ÷ equiv. heating surface	34.80
Total weight ÷ total heating surface	74.00
Total weight ÷ equiv. heating surface	60.80
Volume, four cylinders, cu. ft.	13.00
Total heating surface ÷ vol. cylinders	210.00
Superheater surface ÷ vol. cylinders	31.3
Equiv. heating surface ÷ vol. cylinders	257.00
Grate area ÷ vol. cylinders	3.3

CYLINDERS.

Kind	Simple
Number	4
Diameter and stroke	17½ x 26

VALVES.

Kind	Piston
Diameter	10 in.
Greatest travel	5 in.
Outside lap	1 1/32 F.—31/32 B.
Inside clearance	⅛ in.
Lead, constant	7/32 F.—9/32 B.

WHEELS.

Driving, diameter over tires	73 in.
Driving, thickness of tires	3½ in.
Driving journals, diameter and length	11 x 11 in.
Engine truck wheels, diameter	33 in.
Engine truck, journals	6 x 12 in.
Trailing truck wheels, diameter	45 in.
Trailing truck journals	8 x 14 in.

BOILER.

Style	E. W. T.
Working pressure	160 lbs.
Superheater, type	Cole Sideheader
Outside diameter of first ring	68⅛ in.
Firebox, length and width	102 3/16 x 60⅜ in.
Firebox plates, thickness	5/16 & ½ in.
Firebox, water space	F.—5, S. & B.—4½ in.
Tubes, number and outside diameter	206—2 in.
Tubes, superheater, number and diameter	24—5¼ in.
Tubes, length	18 ft.
Heating surface, tubes	2,551 sq. ft.
Heating surface, firebox	175 sq. ft.
Heating surface, total	2,726 sq. ft.
Superheater heating surface	406 sq. ft.
Equivalent heating surface*	3,335 sq. ft.
Grate area	42.8 sq. ft.
Smokestack, diameter	18 in.
Smokestack, height above rail	15 ft. 1 9/16 in.
Center of boiler above rail	9 ft. 6 in.

TENDER.

Tank	Waterbottom
Frame	Cast Steel
Wheels, diameter	33 in.
Journals, diameter and length	5½ x 10 in.
Water capacity	7,500 gals.
Coal capacity	13 tons

* Equals evaporating heating surface (2,726 sq. ft.) + 1.5 times the superheater surface (406 sq. ft.).

LOCOMOTIVES EQUIPPED FOR FIGHTING FIRES.—In the realization that fires are liable to occur at any time at places which cannot be reached by ordinary extinguishing apparatus, the Pennsylvania has equipped 423 locomotives with fire fighting apparatus. These locomotives are used continually in yard service at various points on the company's lines and are available at all hours of the day and night. On a given signal, their crews, all of which have been trained in fire fighting, hurry their engines to the scene of the fire, and all tracks are cleared that no time be lost en route. So successful has this method of protecting property at out-of-the-way places proved that an additional number of yard engines are being similarly equipped.

THE EQUIPMENT INDUSTRIES AND RAILROAD PROSPERITY.*

W. H. MARSHALL.

A year ago the mere statement of the subject assigned to me would have produced many rueful countenances among those I see before me to-night, for there was no prosperity in evidence for any one except the Western farmer, and he was keeping it pretty much to himself. Adversity was general and the members of this Association were fully informed by personal and painful experience of what railroad depression meant to industrial and commercial interests.

The public was familiar with statistics of railroad earnings showing a loss in gross of from ten to thirty per cent.; they knew great steel interests were running their plants at half of normal output, but they did not know the conditions in related lines of industry—manufacturing concerns dependent almost wholly upon the railroads as customers, whose individual interests may be smaller, but whose aggregate is enormous. Some of these shut down altogether and others ran from one-tenth to one-half of their capacity. Even after the worst was over statistics showed these concerns having 1,500,000 men on their payrolls in good times as employing barely one-half of that number, and not all of them had steady employment. Thus, the losses to employees and to capital engaged in furnishing material, equipment and supplies to railroads was even greater, in proportion at least, than that suffered by the railroads themselves.

But all this has passed into history and to-night we view with smiling faces the picture of railroad prosperity. It calls many to service whose families have suffered from their non-employment. In coal mines from Pennsylvania to Colorado, in the iron mines of the North, in the all but deserted lumber camps of the Northwest and the South and Southwest, all is activity. On the Great Lakes ships are again carrying forty million tons of ore per season to the lower lake ports, furnace fires are lighted in Pittsburg, in the valleys and in the lake cities from Buffalo to Chicago, and the wheels begin to turn in shops all over the land, bringing cheer and comfort to a million families whose bread winners do not work for the railroads, but whose employment is made possible by their activities. And in the background of this picture are merchants, great and small, benefiting by the resumption of buying by the railroads The transportation companies whose prosperity can and does make this picture are owned in a large measure by the people. The money paid for salaries and wages amounts to between 50 and 60 per cent. of the cost of operation, and possibly a larger percentage of what is paid for materials and equipment, whether charged to operation or capital account, goes to labor in the final analysis. Our prosperity, the prosperity of the railroads and of the people are inseparable.

If, therefore, anything is done to increase this prosperity, to lengthen its periods or to minimize the times of inactivity with which it is punctuated the entire people of the country are benefited and the capital and employees we represent come in for their full share.

Realizing that when the railroads were hurt we suffered more than they did, and believing that the attitude of the public and legislative bodies toward great corporations, particularly the railroads, was injurious and to some extent unjustifiable, this Association was formed one year ago. As the welfare of the public and the railroads is inseparable and as our welfare is bound up with that of the railroads, we have labored for our own well-being, confident that success meant a benefit to all and injury to none. We have championed the cause of the railroads for the reason that it was our cause, but we have done so only when we believed they were right. We have sought no favors or privileges, for them or for ourselves, but we have pleaded for calmness and good temper in the consideration of all differences between them and the public, and have endeavored to demonstrate how disastrous to us is injury to them. We are not obstructionists. We believe reasonable regulation of the railroads is right and will injure no one.

The efforts of ourselves and others working along similar lines have been attended with a measure of success, and right-thinking people have come to realize there was something wrong in the situation of a year ago. The agitation against railroads has diminished. The pendulum is swinging in the right direction. To do what we can to prevent its return is now the important problem to which we should apply ourselves.

During our one year of existence as an Association, we have had ample opportunity to study the situation. Two facts stand out prominently; first, that we are suffering from a great excess of legislation, and second, that for some reason the managements of railroads, in too many cases, do not reach the heart and sympathy of the people.

Few are aware of the total volume of legislation placed annually upon our statute books. In the last regular session of Congress there were introduced 28,440 bills, and in the 1909 session of thirty-nine state legislatures there were introduced 45,330 bills, or a total of 73,770. During that period Congress enacted 326 bills (exclusive of pension bills) and the thirty-nine state legislatures 12,508, or a total of 12,834 bills that became laws. In the session of the British Parliament, completed in 1908, 547 bills were introduced and 239 became laws. In the United States there was one bill introduced for approximately every 1,000 inhabitants and in Great Britain one for every 77,000. In the United States there was one bill enacted for every 6,000 inhabitants, while the British Parliament enacted one for every 175,000 inhabitants of the United Kingdom. Does not even a most charitable contemplation of this volume of legislation force the conclusion that it cannot all be deliberate or wise, or just or necessary? Is not the necessity of culling out over 60,000 proposals to legislate a most serious matter? And can any one doubt that the weeding out process should have been more complete and that we all would have been better off with much less than 12,834 new laws?

An illustration of the embarrassment of hasty legislation is the corporation tax law. In referring to this particular law there is no intent to assail its purpose as wrongful, but merely to cite it as the most recent example of important, far-reaching legislation entered upon precipitately. It was introduced towards the end of the last session of Congress and rushed through with every evidence of lack of study. It is an attempt to tax the profits of corporations, but apparently those who framed it were ignorant of modern methods of accounting At any rate, the law as passed will tax the net amount of cash added to assets during the year, whether that bears any relation to profit or not. Expert accountants say it is impossible to make the reports required by the law from accounts as now kept, and that accounts must be kept in two ways, involving needless expense and work. Furthermore, to add to the complexity of the situation, the railroads cannot keep their books in a way that will permit of reporting under the new law without violating the instructions of the Interstate Commerce Commission and being in danger of incurring penalties therefor. Did time permit, illustrations could be multiplied to

* Address at the annual dinner of the Railway Business Association, Waldorf-Astoria Hotel, New York, November 10, 1909.

show that even when the objects to be attained are worthy, much of our legislation is imperfect.

The great volume of legislation leads to much that is inconsistent. State laws conflict with Federal laws and are at variance with the laws of other states. A railroad finds it is compelled to do in one state something it is prohibited from doing in an adjoining state and must at times go to the courts to determine which of two laws it will obey, it being impossible to conform to both. This confusion will not disappear until the volume of new legislation is reduced to an amount that will permit of proper care in the preparation of each and every law. When this is accomplished we shall have fewer new laws and they will be the kind we need.

One great obstacle to the correct framing of proposed laws is the suspicion with which most attempts to enlighten are received. Perhaps it is unfortunate that expert knowledge of the subject with which it is intended to deal is generally found chiefly among those to be affected by the legislation, for the reason that information from such sources is considered to be prejudiced. But legislation to be right must be based upon knowledge, and if that knowledge can be made complete only by contributions from interested parties, it is the duty of our legislators to throw aside suspicion and consult those who will be affected by the legislation. To justify such a course their advances must be met by perfect frankness, and a cordial recognition of the rights of the public. Unreasoning opposition to legislation as such will not succeed. That which is unnecessarily restrictive or injurious in proposed legislation must be shown to be so with reasons that are true and convincing. Lack of frankness in the past and failure to freely concede to others their rights undoubtedly accounts for much of the antagonism of recent years, and it would seem as if the rapidity with which it is to be eradicated will be measured by the completeness of the change in attitude on the part of the railroads and other corporations.

It is also true that in the few instances in which railroads have been consulted on proposed legislation, no unanimity of opinion was to be found among them. There is some excuse for this, for the railroad managements represent interests located in various sections of the country, and what is best for one section may not fit any too well into the conditions found in another. The people have an example in the recent tariff law of the difficulties of reconciling interests in all parts of this great country, and what applies to general business is true of railroads. Nevertheless, railroads cannot expect to be of service in clarifying the situation, until they can agree among themselves as to the form legislation should take. If the layman consults the experts and they hopelessly disagree, what is he to do? He will get along without the experts.

It has been stated that the railroads do not reach the hearts and sympathies of the people. That the wrongs of past management are wholly responsible for the present feeling we do not believe. With the correction of many of these wrongs (at which every broadminded official rejoices) the feeling of resentment should disappear, and while we are glad to see conditions improving, the fact that the change is not as rapid as expected, points to something yet remaining to be done.

A railroad management should not lose sight of the fact that in its task of conciliation special attention must be given to the small shipper, to the passenger who travels but a few miles on its trains and to local communities. The big shipper can take care of himself, or can at least make a demonstration that will result in his grievances being duly considered. Not only is it difficult to do justice to the smaller interests through the instrumentality of minor employees in an organization as complex and extensive as that of a railroad, but the railroad is at a further disadvantage as compared with a commercial or manufacturing business. In a commercial house improper treatment of customers is quickly noticed, as it leads to loss of business, for the patron can go elsewhere, but if the local patron of a railroad is not treated right, revenues are not reduced. He must use the railroad company any way, but his exasperation is all the greater because he is helpless. It is not sufficient that those at or near the top of an organization should have the right spirit; that spirit should permeate the entire organization. It always does as a matter of fact, but unless determined effort is made it permeates too slowly. Whatever of effort is made in this direction has a twofold reward; it brings appreciation from the public and it improves the relations between employer and employee. Nothing adds more to the faith and loyalty of the kind of men all corporations wish to retain in their employ than daily evidences of strict justice to others. A full realization of all these conditions should lead to greater vigilance in the maintenance of correct relations with the public.

If some of these remarks are in the nature of criticism of our railroad friends, it should be borne in mind that they are uttered in the most friendly spirit. The justification for alluding to them lies in our belief that the better relations between the railroads and the people and the representatives of the latter sent to our legislatures, which we so ardently desire and for which we are working, cannot be advanced by ignoring any practical side of the situation.

And now in conclusion permit me to reiterate that railroad prosperity is everything to the interests represented in this Association. Knowing well the difficulties in the present situation we, nevertheless, are optimistic. That both sides may be now to some extent in the wrong does not shake our belief in the good sense of the public and wisdom on the part of railroad managements. We are confident the differences between the public and the railroads will finally be adjusted in a spirit of fairness and good temper on both sides, and with patience—not a patience that accomplishes nothing of reform, but a patience that while progressive is painstaking and thorough.

Does not our history justify such a faith? Important as are our present day problems, have not greater ones been solved already?

Surely a people that has by its energy, industry and intelligence accomplished so much in but little more than a century of national life is not going to fail when confronted with the task of correcting, with a minimum of injury to itself, evils brought about by its own growth. Nor is it conceivable that railroad men who have built and who are daily extending and operating these great transportation lines, men possessed of all the integrity, ability and application vital to such achievements, will be found wanting when weighed in the scales of public opinion.

TRAIN RESISTANCE FORMULAS.

In two issues of *The Engineer* (March 26 and April 2, 1909), Lawford H. Fry brings together for comparison some of the more important formulas for train resistance which have appeared since the presentation of the elaborate paper of Mr. Aspinall to the Institution of Civil Engineers in 1901. He describes briefly the methods employed by Nadal and Conte in France, Sanzin in Austria, and by Frank and Von Borries in Germany, to develop rational formulas to represent the results obtained experimentally; after which he proposes the following new formulas which give results agreeing fairly with the mean of the various experimental determinations:

Four-coupled Locomotives:—

$$R = 3.8 + 0.0435V + 0.0018V^2$$

Six-coupled Locomotives:—

$$R = 4.5 + 0.0563V + 0.0018V^2$$

Eight-coupled Locomotives:—

$$R = 6. + 0.21V + 0.0018V^2$$

(Locomotive and tender considered as a single unit.)

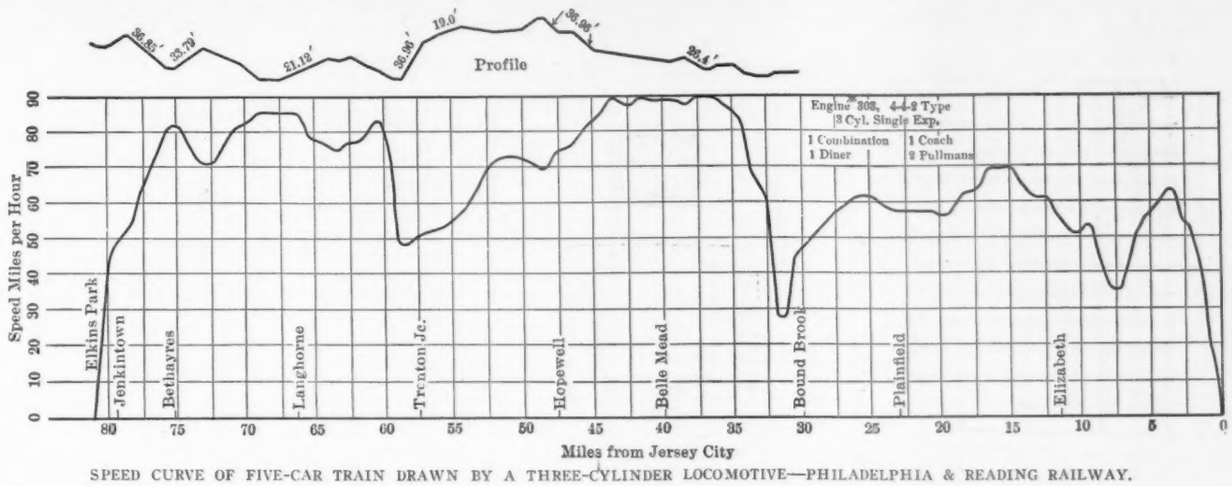
Four-wheeled Cars:—

$$R = 1.6 + 0.032V + 0.0012V^2$$

Bogie Coaches:—

$$R = 1.6 + 0.013V + 0.001V^2$$

In these formulas V = speed in miles per hour, and R = resistance in lbs. to move each 1000 lbs. of locomotive or car weight. They do not apply for speeds less than about ten miles per hour.



SPEED CURVE OF FIVE-CAR TRAIN DRAWN BY A THREE-CYLINDER LOCOMOTIVE—PHILADELPHIA & READING RAILWAY.

A FAST RUN ON THE NEW YORK BRANCH OF THE PHILADELPHIA & READING RAILWAY.

BY "EAGLE EYE."

There are few, if any, cities in the United States, which can boast of an intercommunicative train service superior to that maintained by the Philadelphia & Reading Ry. and the Pennsylvania R. R. between New York and Philadelphia. The fastest trains on both roads make the run in two hours, and as this includes the time required to ferry passengers across the Hudson River, the distance of approximately 90 miles between Jersey City and Philadelphia must be covered in about one hour and forty-five minutes. Including stops, of which at least two are always made, the average speed is thus about 50 miles per hour.

The accompanying log represents a run recently made by train No. 602 on the Philadelphia & Reading Ry. This train leaves Philadelphia at 8:00 A. M., and is scheduled to stop at Columbia Ave., Wayne Junction, and Elkins Park, the last named a suburban station 9.2 miles from the Philadelphia terminal. The 81 miles from Elkins Park to Jersey City are scheduled to be run in 89 minutes, equivalent to 54½ miles per hour. In the present instance the train was composed of one combination baggage and smoker, one coach, one diner and two Pullmans, estimated to weigh between 275 and 300 tons. The engine was No. 303, a three cylinder single expansion Atlantic type with superheater. The cylinders are 18½ x 24 in. and the drivers 80 in. diameter. This locomotive was built in the company's shops at Reading in the spring of 1909, and was exhibited at the annual convention of the Master Mechanics' Association, where it attracted much attention because of the novelty of its design and the superior workmanship and finish of its various parts. It was illustrated and briefly described on page 459 of the November issue of the AMERICAN ENGINEER.

The data for the log shown was secured by a passenger (myself) on the train, who, with the help of an ordinary watch, carefully noted the time in hours, minutes and seconds, of passing each mile post. In this way any cumulative error is impossible; the elapsed time between terminals absolutely correct, and I believe that the errors for the individual miles in no case exceed one second. Previous to its arrival at Elkins Park, the train was slowed several times, and it left the station at 8:24:00 instead of at 8:19:00 as per schedule. The locomotive accelerated rapidly, and Bethayres, six miles from Elkins Park, was passed at a speed of nearly 82 miles per hour. Between this point and the Delaware River there are a number of favorable stretches for high speed, and the maximum recorded was 42 seconds to the mile, equivalent to 85.7 miles per hour. At mile post 60 speed was reduced to scoop water, and the train started up the grade of 37 feet per mile, east of the Delaware River, at about 50 miles per hour. This grade is easier toward the summit, where the slope is 19 feet per mile; its total length is about five miles, and the summit was passed at a speed of nearly 60 miles per hour. On the favorable stretch east of Hopewell the speed increased rapidly, and at three points reached 90 miles per hour (40 seconds per mile). Near mile post 33 a sharp reduction took place, incident to crossing the Lehigh Valley tracks at grade, and running through the junction of the Reading's New York branch and the Central Railroad of New Jersey. Bound Brook was passed at moderate speed, and the remainder of the run calls for no special comment. Jersey City was reached, in advance of schedule time, at 9:43:18.

In this connection the following facts are worthy of note:—

The highest speed recorded was 90 miles per hour.

The 17 miles from mile-post 77 to mile-post 60 were run in 12 minutes 56 seconds, at an average speed of 79.0 miles per hour.

The 12 miles from mile-post 46 to mile-post 34 were run in 8 minutes 13 seconds, at an average speed of 87.6 miles per hour.

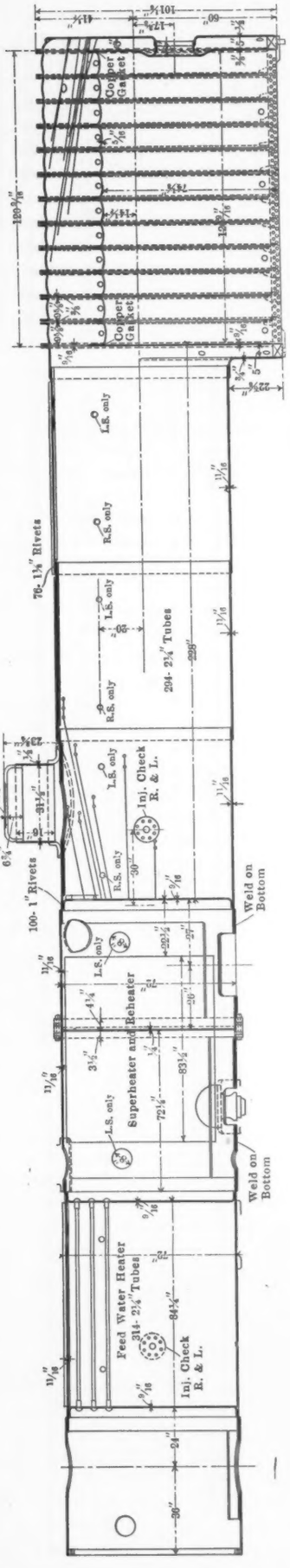
The 49 miles from Elkins Park to mile-post 32 were run in 41 minutes 34 seconds, at an average speed of 70.7 miles per hour..

The entire distance of 81 miles from Elkins Park to Jersey City were run in 79 minutes 18 seconds, at an average speed of 61.4 miles per hour.

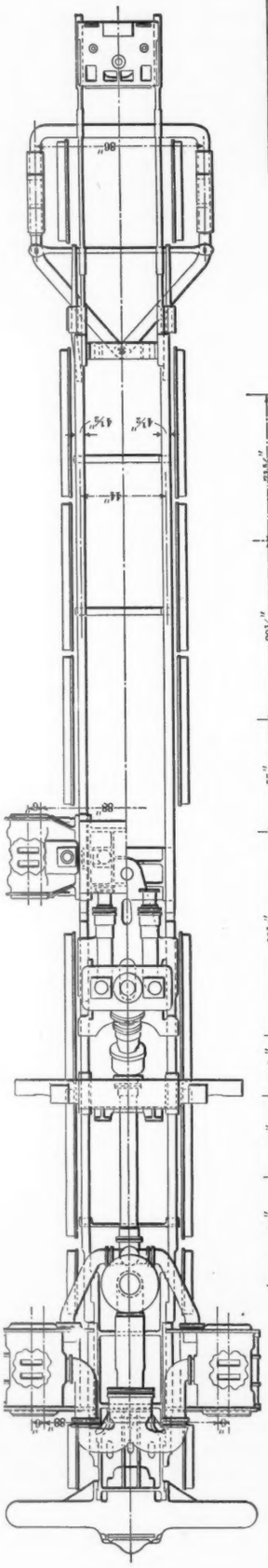
If the average speed of 70.7 miles per hour had been maintained for the last 32 miles, the train would have reached Jersey City at 9:32:42. This fact certainly suggests the entire possibility if not the feasibility, of running from Philadelphia to New York in one hour forty-five minutes, including the ferry across the Hudson. Furthermore, it should be remembered that this run was made over the old road via Jenkintown. It is the usual practice to run the two hour trains over the new cut-off between Wayne Junction and Neshaminy Falls, which is a shorter and easier route than the one via Jenkintown. The stop at Elkins Park, however, makes it impossible for train 602 to use the cut-off.

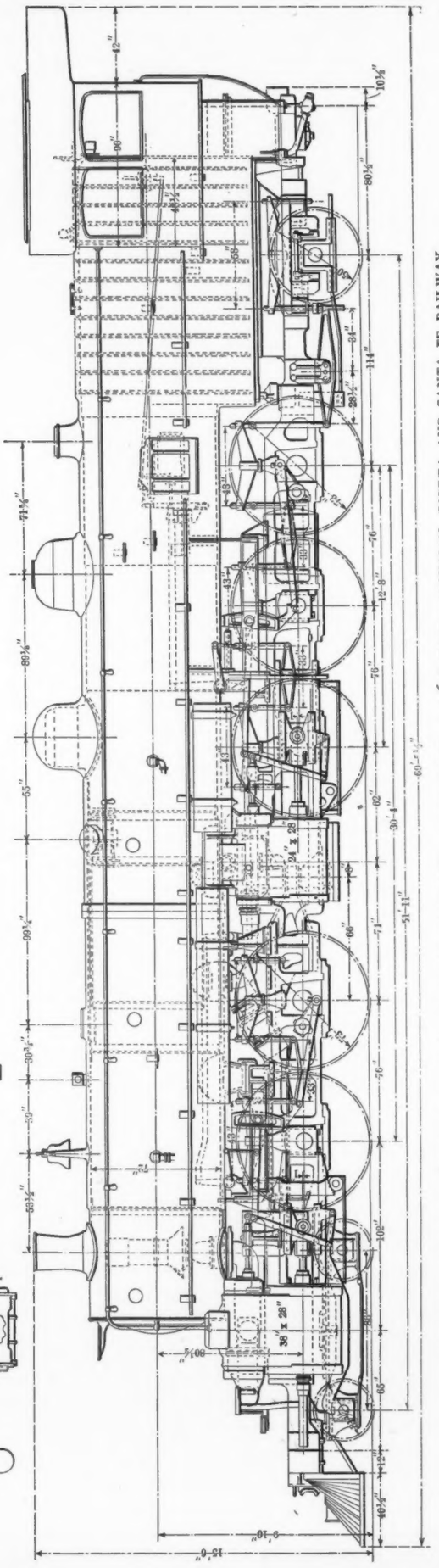
This run was of course made without special preparation, and took place on a .snowy morning with a consequently wet rail. It is of special interest in that it was performed by an experimental locomotive, possessing features new to American practice. The engine accelerated the train rapidly and appeared to handle it with great ease; and the performance throughout was highly creditable to the locomotive and all concerned.

TELEPHONE TRAIN DISPATCHING.—The Atchison, Topeka and Santa Fe Railway has recently installed the telephone for train dispatching between Chicago and Newton, Kansas, a distance of 659 miles. This is but a small portion of what is being equipped, it being the intention of the railway company to extend this service over its entire system. At the present time there are eighteen different divisions upon which the trains are dispatched by telephone. In this way 380 stations are reached in a total distance of 1,925 miles. The telephone equipment being used was furnished by the Western Electric Company.



BOILER, INCLUDING SUPERHEATER, REHEATER AND FEEDWATER HEATER—MALLET ARTICULATED COMPOUND PASSENGER LOCOMOTIVE, 4-4-6-2 TYPE.





ELEVATION AND PLAN (BOILER REMOVED) OF MALLET PASSENGER LOCOMOTIVE, 4-4-6-2 TYPE—ATCHISON, TOPEKA AND SANTA FE RAILWAY.

RECORD BREAKING FREIGHT AND PASSENGER LOCOMOTIVES FOR THE SANTA FE.

ARTICULATED AND BALANCED COMPOUND ENGINES WITH SUPERHEATERS AND REHEATERS.

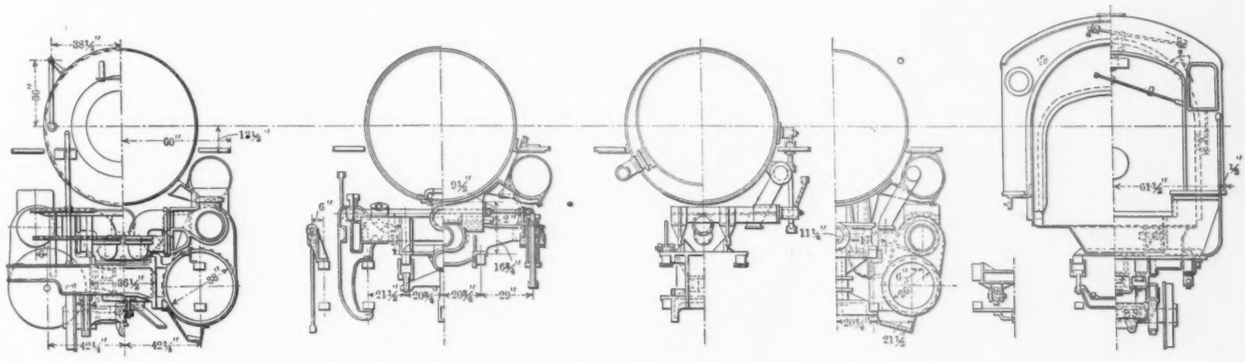
The Baldwin Locomotive Works are delivering to the Atchison, Topeka and Santa Fe Railway two passenger and two freight locomotives, both of which in their respective classes are the heaviest and most powerful ever built; these were illustrated in outline in the January number, page 16. Accompanying this order are also several of the balanced compound Atlantic type, which in general are similar to those which have been in very successful service on this road for a number of years, but differ from their predecessors in being equipped with a superheater, reheater and Walschaert valve gear.

The passenger locomotives are a complete and distinct departure from anything that has ever been built before for this service, being a Mallet articulated compound design of the 4-4-6-2 type and weighing 376,450 lbs., of which 268,000 lbs. is on drivers. They have a tractive effort of about 53,000 lbs. The freight locomotives weigh 462,450 lbs., thus exceeding the Southern Pacific engines by 36,550 lbs. in total weight, and having 18,200 lbs. more weight on drivers. Both of these designs are arranged to traverse 16° curves. The Atlantic type engines weigh 222,150 lbs., of which 114,800 lbs. is on drivers, making them the heaviest of this type, in respect to total weight, on our records. These engines are the latest development of a very interesting series of locomotives, which have given most excellent results in high speed passenger service. They have been remarkable in the amount of mileage performed between repairs, according to records given in the *Santa Fe Employees' Magazine.* Of two engines which were received in October, 1904, one made 205,262 miles before general overhauling, with an average total repair cost up to that time of 4.8 cents per mile. The other made 184,399 miles at a cost of 4.3 cents per mile. One engine received in August, 1905, was not sent to the shop for general overhauling until July 21, 1909, and had made a mileage of 227,902 miles.

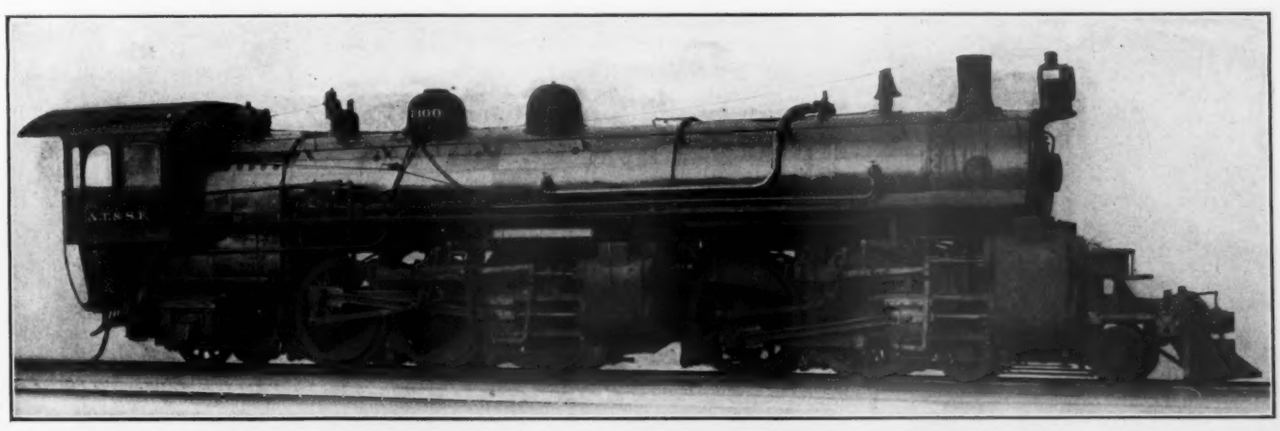
The different designs will be taken up and discussed separately.

Mallet Articulated Passenger Locomotives.

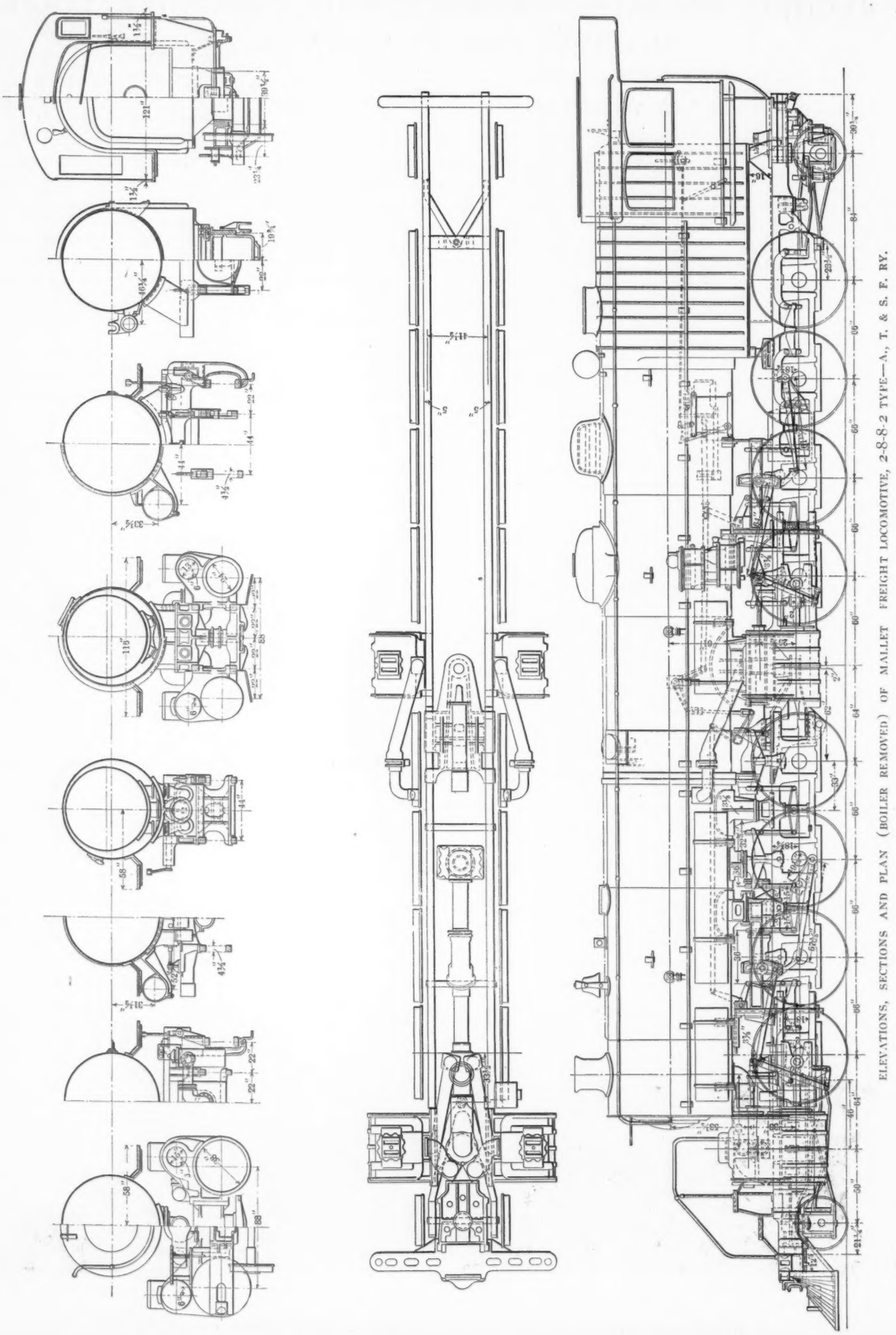
A passenger locomotive giving a theoretical tractive effort of 53,000 lbs. but a few years ago would have been considered a practical impossibility. This is about 50 per cent. more power than is given by the present most powerful engine having driving wheels over 70 inches in diameter. As regards total weight it is a jump of over 100,000 lbs. from the present record. In spite of this enormous increase in size and power the success of the machine, so far as general features are concerned, is practically guaranteed, since it does not differ from the articulated freight engines, that have proven to be an operating success in most cases, except in size of wheels and the application of the four-wheel truck. In effect it is a combination of the American type with a Pacific type, the equalizers and arrangement of spring rigging being the same as on those types.



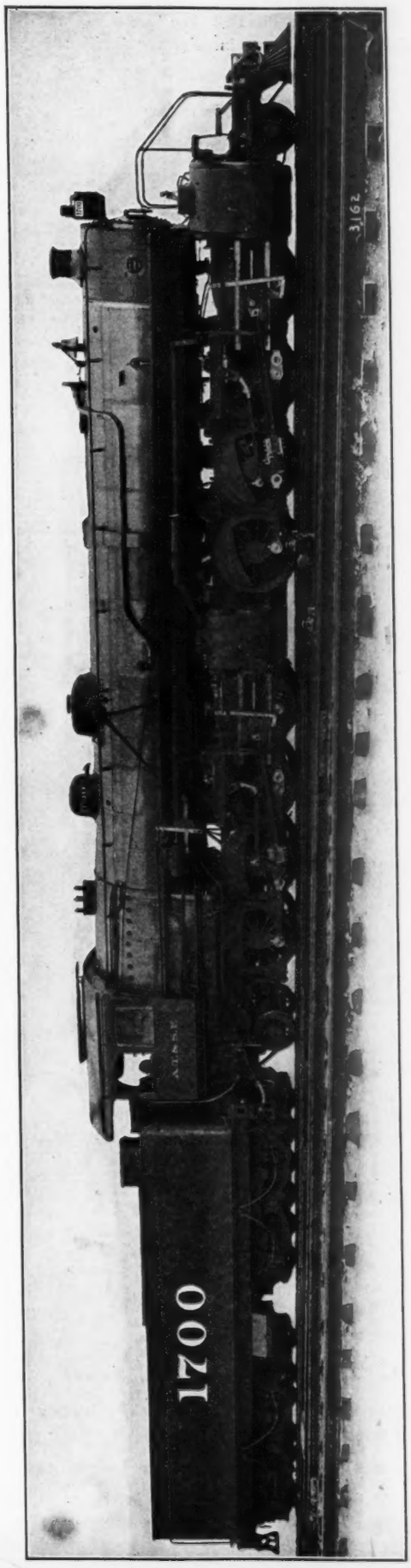
END ELEVATION AND SECTIONS OF MALLET PASSENGER LOCOMOTIVE.



MALLET ARTICULATED COMPOUND PASSENGER LOCOMOTIVE, 4-4-6-2 TYPE—A. T. & S. F. RY.



ELEVATIONS, SECTIONS AND PLAN (BOILER REMOVED) OF MALLET FREIGHT LOCOMOTIVE, 2-8-8-2 TYPE—A., T. & S. F. RY.



HEAVIEST AND MOST POWERFUL LOCOMOTIVE IN THE WORLD—ATCHISON, TOPEKA AND SANTA FE RAILWAY.

In many ways this design follows the scheme used on the Southern Pacific articulated compound engines built by the same company, which were illustrated on page 181 of the May and 367 of the September, 1909, issues of this journal. The articulated frame connection is very similar and reference to the September number will show its details. A distinct difference, however, is found in the supporting of the overhang of the boiler in the front group of frames, which in this case is done by a single support, located between the driving wheels, in which is contained the centering device. The construction of the low pressure cylinders and frame connections are practically the same as on the Southern Pacific design.

While the boiler of these locomotives contains a feed water heater and combustion chamber and has a separable joint just ahead of the high pressure cylinders, the same as is on the Southern Pacific design, it differs in having no reheater in the front end, but in employing both a superheater and a reheater which are located in the combustion chamber. It is also fitted with a Jacobs-Shupert fire box. This type of fire box has been very fully illustrated and described in these columns and needs no further description. The construction and arrangement of the superheater will be taken up later.

Oil fuel is used, the burner being placed at the front end of the fire box and the oil being fed through a heater, consisting simply of a long steam jacketed pipe, the details being arranged according to the railroad company's practice. The valve gear is of the Walschaert type, being controlled by a Ragonnet power reversing gear.* This construction is very similar to that on the Southern Pacific design, differing in detail, however, because of the location of the steam and exhaust pipes. The tender of these engines is the same as those on the freight locomotives and will be discussed later.

ARTICULATED FREIGHT LOCOMOTIVES.

It would seem as if a locomotive giving a tractive effort of 108,300 lbs., and having the largest total weight of any engine ever built would deserve a very full description in these columns. Due to the fact, however, that the Mallet articulated compound designs have been very fully described and illustrated in previous numbers, and that this engine is practically a development from the Southern Pacific design, reference to the description of which is given above, there is comparatively little that can be said concerning it that is not clearly shown in the illustrations. Practically all of the new or especially interesting features of the design are contained in the boiler, which is an enlarged edition of the one applied to the passenger locomotives discussed above. The fire box is of the Jacobs-Shupert design, has a grate area of 70.8 sq. ft. The locomotives, however, are designed to burn oil, being arranged the same as the passenger engines. The barrel of the boiler is of the straight type, the circular sheet next to the fire box measuring 85⅞ in. internal diameter.

The evaporative section of the boiler contains 387 2¼-in. tubes, 21 ft. long, which terminate in a combustion chamber 10 ft. 9 in. long, containing a superheater and reheater. In front of this is the feed water heater having 417 2¼-in. tubes 6 ft., 8 in. long, giving a heating surface of 617 sq. ft. Then comes the ordinary front end, which is 55 in. in length from the tube sheet. This gives a boiler 54 ft. 4 1-16 in. in length over all, which is formed in two parts, having the separable joint located 36¼ in. ahead of the flue sheet in the combustion chamber. This joint, and the arrangement of pipes around it, is the same as in the passenger engines and the same as was used on the Southern Pacific design.

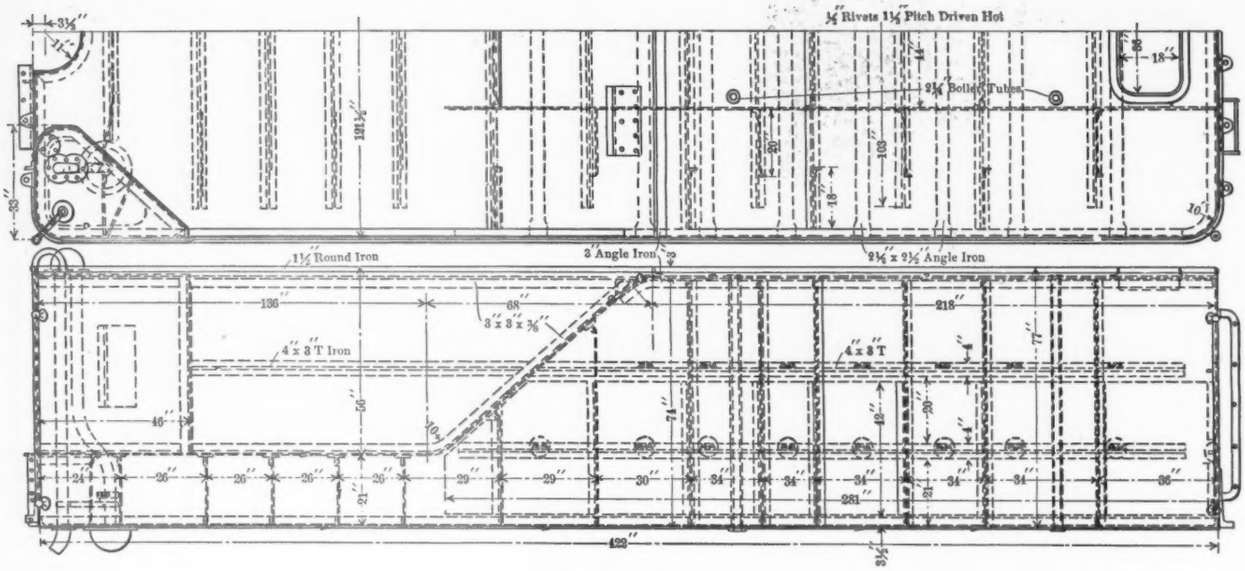
The general dimensions, weights, etc., of these locomotives are given at the end of this article.

12,000 GALLON TENDER.

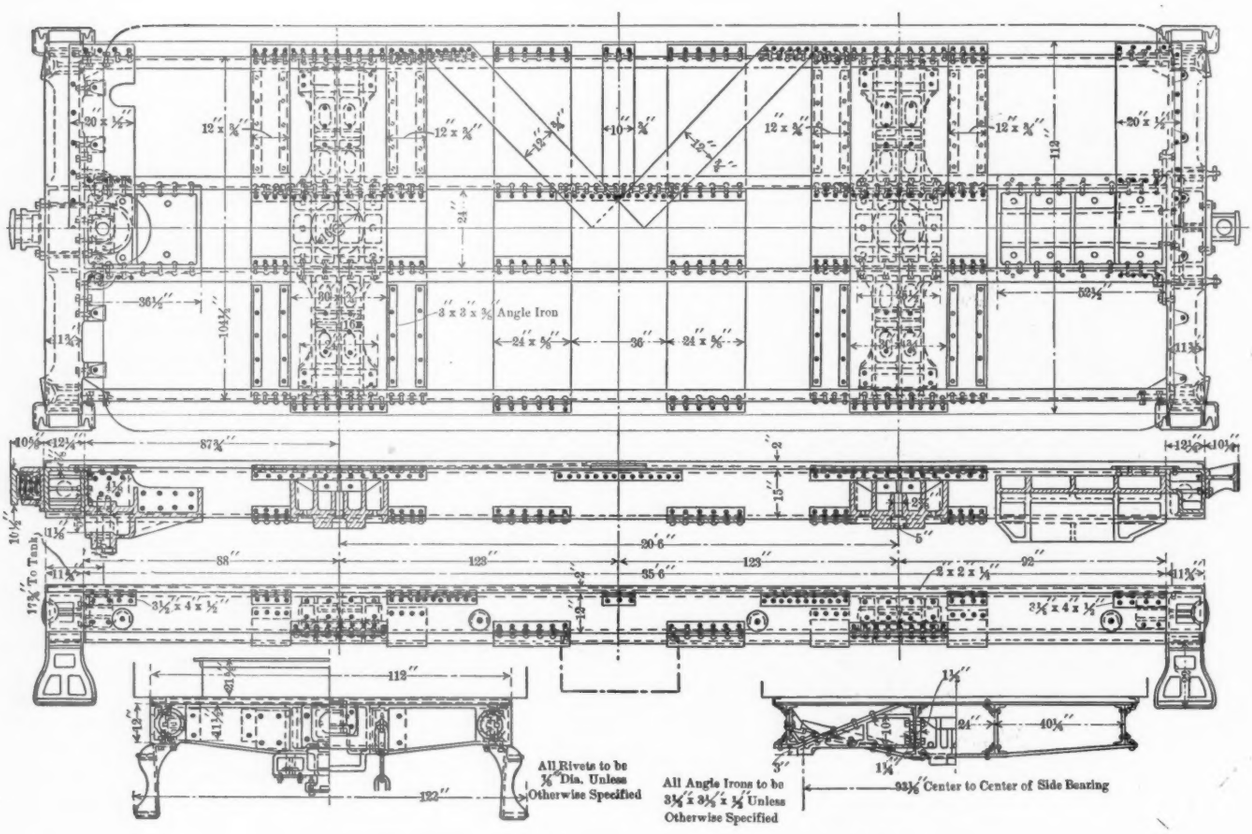
Some remakable tenders have been applied to these Mallet compound locomotives, being far in excess, both as respects capacity and weight, of anything that has ever been built for

* See AMERICAN ENGINEER, July, 1908, page 260.

locomotive use before. They have a capacity of 12,000 gallons of water and the coal space is taken up by a tank with a capacity of 4,000 gallons of oil. The very large weight of this amount of water and oil together with the great weight of the casting, which is seated on the bolsters and bridges the middle transoms. The latter are cast in one piece with the truck frame. The design of the tank has been carefully considered and splash plates have been intelligently distributed to prevent



12,000 GALLON TANK—A., T. & S. F. RY.



UNDERFRAME FOR 12,000 GALLON TENDER—A., T. & S. F. RY.

tender itself requires the use of two six-wheel trucks.

On the underframe, 15 in. channels are used as center sills and 12 in. channels as side sills; the front and back bumpers being of cast steel of very substantial design. The illustrations show the constructional details of the underframe as well as the tank and six-wheel trucks. The latter are practically the same as a passenger car truck and have the frames and pedestals of cast steel. The center plate is in one piece with a heavy steel both longitudinal and horizontal surging. The bracing is well designed and ample.

Atlantic Type Balanced Compound Locomotives.

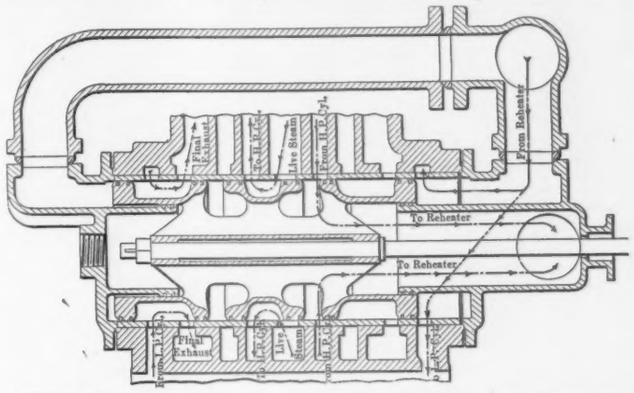
As mentioned before, these engines are a development of those which have been in service for a number of years. The later examples have 79 in. drivers instead of 73 in. as did the earlier ones. The most interesting features of difference in this later

design are found in the application of the superheater and reheater in the front end of the boiler and in the Walschaert valve gear. The former will be discussed later.

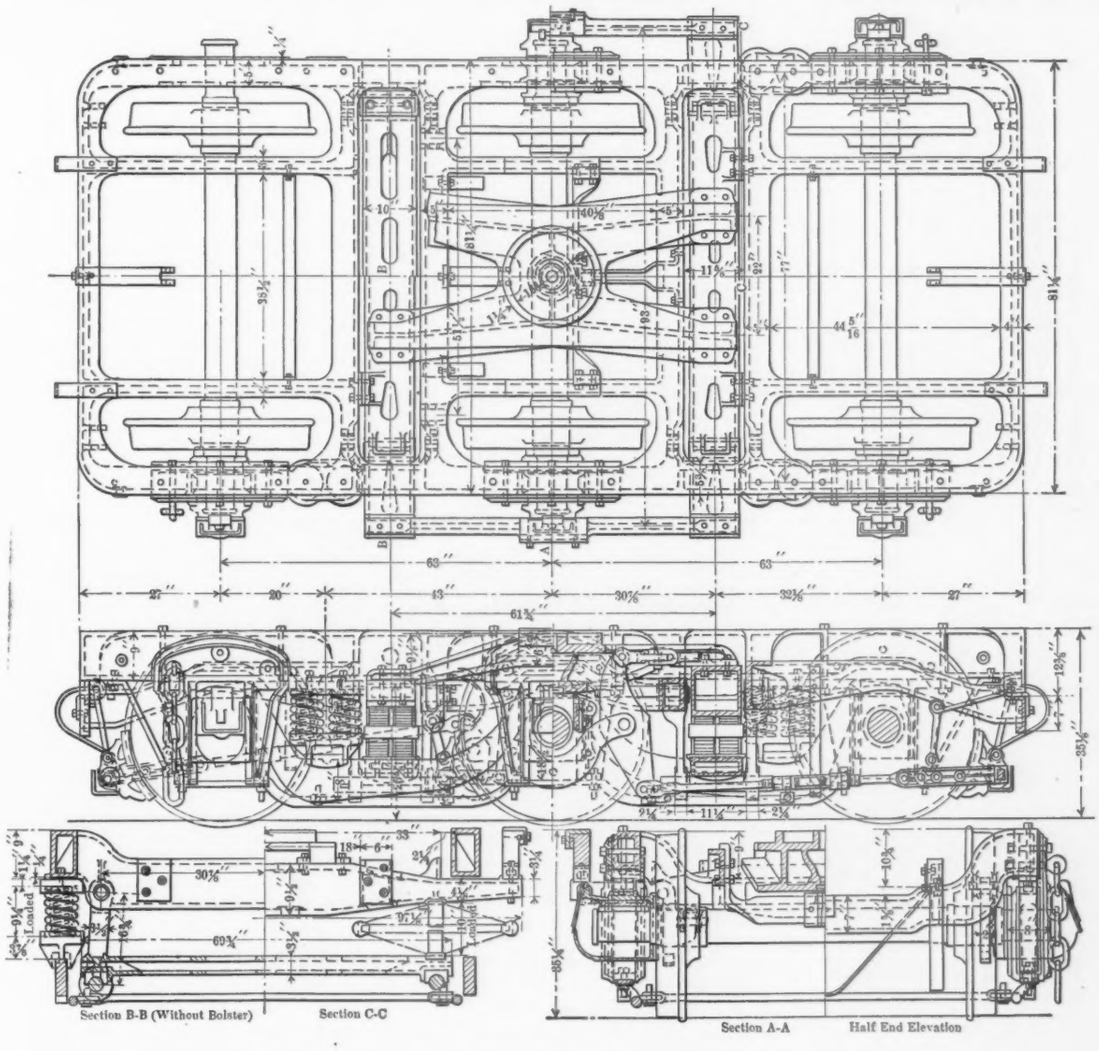
An interesting arrangement of valve gear has been applied in which the link is back of the main crank pin. All the main rods are connected to the leading pair of drivers, eccentric cranks being secured to the main pin. The link is supported by a cross bearer of cast steel, which spans the frame between the two pairs of drivers and is operated by an eccentric rod 48¾ in. long, the connection to the foot of the link being on a line with the center of the axles. The radius bar is 98 in. in length and connects to the combination lever, which is carried by a rocker resting in a bearing secured to the guide yoke. The inner arm of this rocker is connected to a long valve stem, which has no intermediate supports. The union link extends back from the cross head connection and is 38⅛ in. in length. The reversing is accomplished by a connection to the radius bar through a 19¾ in. link from the arm of the reverse shaft, which is supported on top of the frame cross bearer that carries the link bearing.

The crank axle is of the built-up type, with a cast steel center web, that has given satisfactory service on this type of power. The trailing wheels have outside journals, the box being bolted to the truck frame, which is clamped to the main frames, thus preventing any radial motion. The main frames are of

ing the superheater the steam enters two connections which lead to the main admission ports in the valve chamber. The distribution at this point is practically the same as in former locomotives of the Vauclain balanced compound type. Internal admission is provided for each high pressure cylinder, from which the steam exhausts into the hollow interior of the valve. From this point the steam is carried through an extension having a steam tight



SECTION OF VALVE CHAMBER AND VALVE—ATLANTIC TYPE BALANCED COMPOUND WITH SUPERHEATER AND REHEATER.

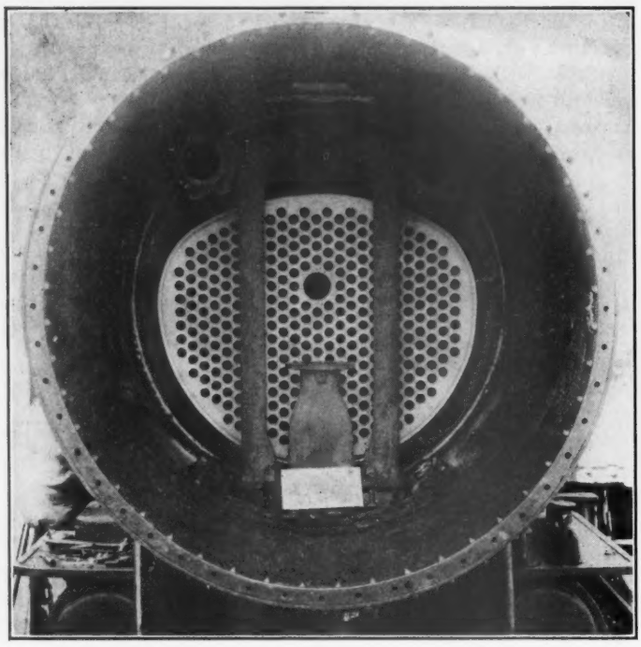


SIX WHEEL TRUCK FOR 12,000 GALLON TENDER—A., T. & S. F. RY.

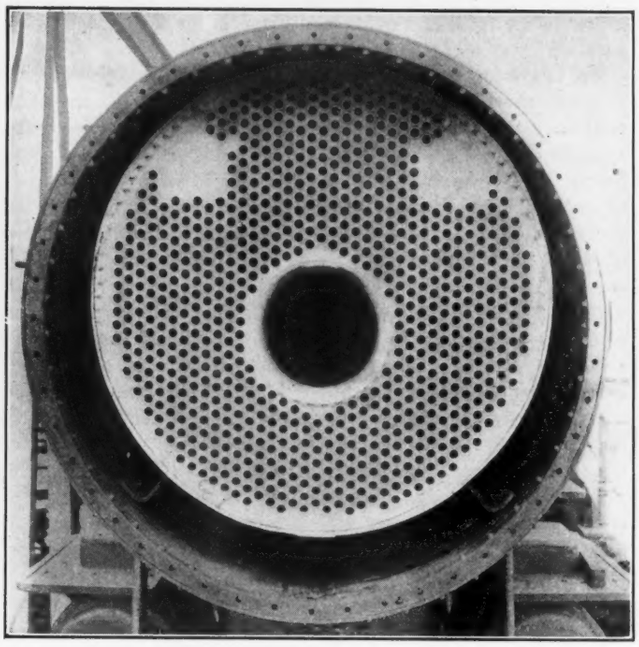
cast steel with comparatively light, single front rails of forged iron.

One of the illustrations shows a section through the steam chest from which the passage of the steam to and from the valve, both to the superheater and reheater, are illustrated. After leav-

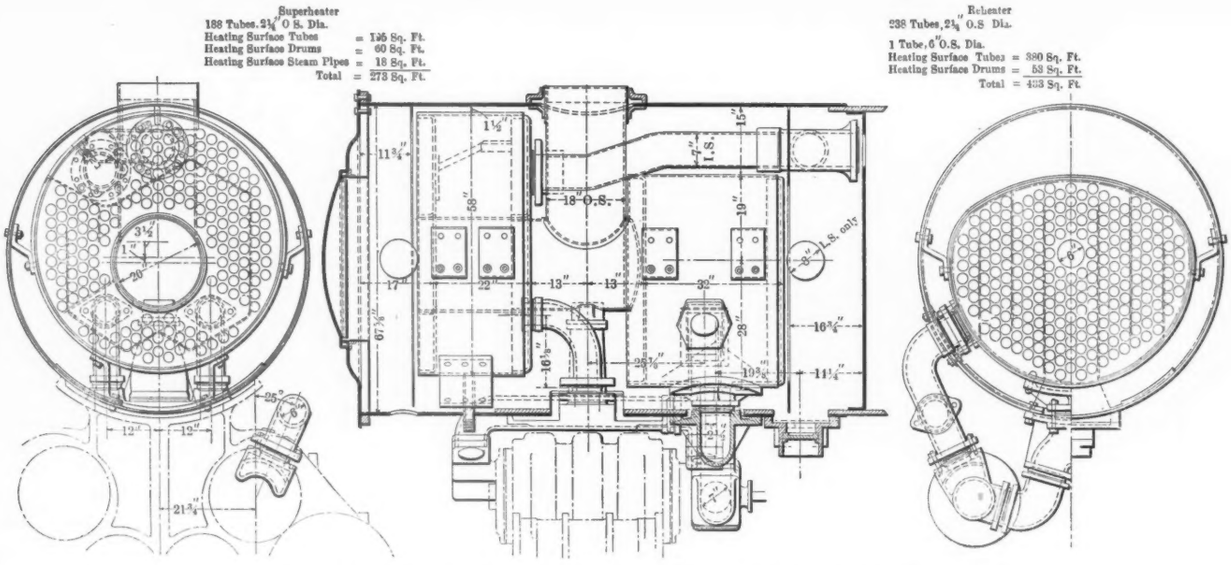
fit with the internal part of the valve to the reheater. This connection is only made at the back end of the valve. After leaving the reheater it is conveyed by suitable pipe connections back to the steam chest heads, in which it enters by means of openings which practically surround the exhaust passage just mentioned,



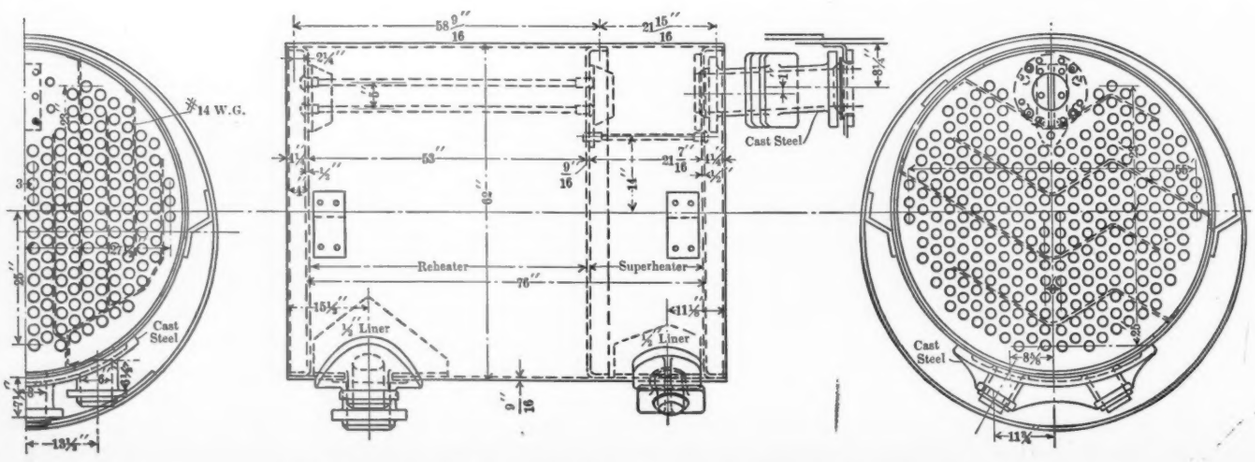
VIEW OF REAR DRUM OF JACOBS SUPERHEATER.



VIEW OF FRONT DRUM OF JACOBS SUPERHEATER.


Superheater
188 Tubes, 2¼" O.S. Dia.
Heating Surface Tubes = 135 Sq. Ft.
Heating Surface Drums = 60 Sq. Ft.
Heating Surface Steam Pipes = 18 Sq. Ft.
Total = 273 Sq. Ft.
Reheater
238 Tubes, 2¼" O.S Dia.
1 Tube, 6" O.S. Dia.
Heating Surface Tubes = 380 Sq. Ft.
Heating Surface Drums = 53 Sq. Ft.
Total = 433 Sq. Ft.
I.S.
O.S.
I.S. coil

ELEVATION AND ARRANGEMENT OF JACOBS SUPERHEATER FOR COMPOUND LOCOMOTIVE.



BUCK SUPERHEATER AND REHEATER FOR MALLET COMPOUND LOCOMOTIVES.

GENERAL DATA.			
Type	4-4-6-2	2-8-8-2	4-4-2
Gauge	4 ft. 8½ in.	4 ft. 8½ in.	4 ft. 8½ in.
Service	Pass.	Freight	Pass.
Fuel	Oil	Oil	Bit. Coal
Tractive effort	53,000 lbs.	108,300 lbs.	22,150 lbs.
Weight in working order	376,450 lbs.	462,450 lbs.	222,150 lbs.
Weight on drivers	268,000 lbs.	412,350 lbs.	114,800 lbs.
Weight on leading truck	58,050 lbs.	24,050 lbs.	58,550 lbs.
Weight on trailing truck	50,400 lbs.	26,050 lbs.	48,800 lbs.
Weight of engine and tender in working order	600,000 lbs.	700,000 lbs.	392,000 lbs.
Wheel base, rigid	F. 6 ft. 4 in., B. 12 ft. 8 in.	16 ft. 6 in.	15 ft. 9 in.
Wheel base, total	51 ft. 11 in.	59 ft. 10 in.	30 ft. 3 in.
Wheel base, engine and tender	94 ft. 5½ in.	98 ft. 5⅛ in.	62 ft. 4¾ in.
RATIOS.			
Weight on drivers ÷ tractive effort	5.05	3.78	5.20
Total weight ÷ tractive effort	7.10	4.24	10.08
Tractive effort × diam. drivers ÷ boiler heating surface	1115.00	1375.00	650.00
T. E. × D. D. ÷ boiler and feed heater H. S.	812.00	1038.00	.....
Total boiler heating surface ÷ grate area	66.00	70.70	54.30
Total H. S. (boiler and feed heater) ÷ grate area	90.5	98.7	.....
Firebox heating surface ÷ total boiler heating surface, per cent.	5.80	4.72	8.00
Weight on drivers ÷ total boiler heating surface	77.10	82.40	82.70
Total weight ÷ total boiler heating surface	108.00	92.60	82.50
Volume equiv. simple cylinders, cu. ft	20.60	33.10	8.30
Total boiler heating surface ÷ vol. equiv. cylinders	168.20	152.00	324.00
Grate area ÷ vol. equiv. cylinders	2.54	2.14	5.98
CYLINDERS.			
Kind	Compound	Compound	Compound
Diameter and stroke	24 & 38 x 28 in.	26 & 38 x 34 in.	15 & 25 x 26 in.
VALVES.			
Kind	Piston	Piston	Piston
Diameter H. P.	13 in.	13 in.	.....
Diameter L. P.	15 in.	15 in.	.....
WHEELS.			
Driving, diameter over tires	73 in.	63 in.	79 in.
Driving, thickness of tires	3½ in.	3½ in.	3½ in.
Driving journals, main, diameter and length	11 x 12 in	11½ x 12 in.	10 x 10½ in.
Driving journals, others, diameter and length	9 x 12 in.	10 x 12 in.	9 x 12 in.
Engine truck wheels, diameter	31¼ in.	34¼ in.	34¼ in.
Engine truck, journals	6 x 10 in.	6½ x 10½ in.	6 x 10 in.
Trailing truck wheels, diameter	50 in.	34¼ in.	50 in.
Trailing truck, journals	8 x 14 in.	7 x 12 in.	8 x 14 in.
BOILER.			
Style	Straight	Straight	Wagon Top
Working pressure	200 lbs.	220 lbs.	220 lbs.
Outside diameter of first ring	72 in.	84 in.	66 in.
Firebox, length and width	119⅝ x 63¼ in.	129⅝ x 78⅜ in.	107 15/16 x 66 in.
Firebox plates, thickness	5/16, ⅜ & 9/16 in.	5/16, ⅜ & 9/16 in.	⅜ & 9/16 in.
Firebox, water space	F. & B. 5, S. 5½ in.	F. & B. 5, S. 5½ in.	F. 4½, S. 5, B. 4 in.
Tubes, number and outside diameter	294—2¼ in.	387—2¼ in.	273—2¼ in.
Tubes, length	19 ft.	21 ft.	15 ft. 6 in.
Heating surface, tubes	3,275 sq. ft.	4,768 sq. ft.	2,478 sq. ft.
Heating surface, firebox	202 sq. ft.	236 sq. ft.	215 sq. ft.
Heating surface, total	3,477 sq. ft.	5,004 sq. ft.	2,693 sq. ft.
Superheater heating surface	323 sq. ft.	544 sq. ft.	273 sq. ft.
Reheater heating surface	798 sq. ft.	1,201 sq. ft.	433 sq. ft.
Feed water heating surface	1,279 sq. ft.	1,617 sq. ft.	.....
Feed water heater tubes, number and diam.	314—2¼ in.	417—2¼ in.	.....
Feed water heater tubes, length	7 ft.	6 ft. 8 in.	.....
Grate area	52.5 sq. ft.	70.8 sq. ft.	49.5 sq. ft.
TENDER.			
Tank	Water bottom		Water Bottom
Frame	15 & 12 in. channels		
Trucks	6 wheel		4 wheel
Wheels, diameter	34¼ in		34¼ in.
Journals, diameter and length	5½ x 10 in		5½ x 10 in.
Water capacity	12,000 gals		9,000 gal.
Fuel capacity	4,000 gals		12 tons

and goes to the low pressure cylinder ports being controlled by the outer ends of the valve.

JACOBS' SMOKEBOX SUPERHEATER.

A new type of superheater has been in service on the Santa Fe Railroad for more than a year and the results have been such as to lead to its application to a very large number of locomotives, including those of the 4-4-2 type described above.

The superheater is of the smokebox type and consists of two drums, each containing a set of fire-tubes. The drums are located in the smokebox, where steam passing through the drums on its way from the boiler to the cylinders, is raised in temperature by heat from the flue gases that would otherwise go to waste. This superheater is equally applicable to both simple and compound locomotives. When applied to a simple engine the steam passes through both superheater drums before entering the cylinders. When applied to a compound engine steam passes through one drum before entering the high pressure cylinders and passes through the second drum on its way from the high to the low pressure cylinders.

The general arrangement of the superheater and connections is shown by the accompanying photographs which illustrate the parts assembled and also show each drum in the smokebox. The forward drum is cylindrical in shape, while the rear drum is flattened at the top to permit the location of the dry pipe extension above this drum. The drums are made of material as thin as safety will permit in order that all parts will serve as heating surfaces. Each drum contains as many fire-tubes as consistent with the volume of steam space required. In the rear drum the tube ends are welded to the tube sheets, while in the forward drum the tube ends are rolled and beaded. The drums are supported by brackets bolted to the smoke arch and are readily removable.

Between the exhaust pipe and the stack the exhaust is thoroughly enclosed in order that there may be no draft to induce gases direct from the boiler flues to the stack. The enclosed petticoat pipe is connected by an elbow with a large opening through the forward drum. The draft, therefore, is forward through the tubes of both drums and rearward through the large opening of the forward drum.

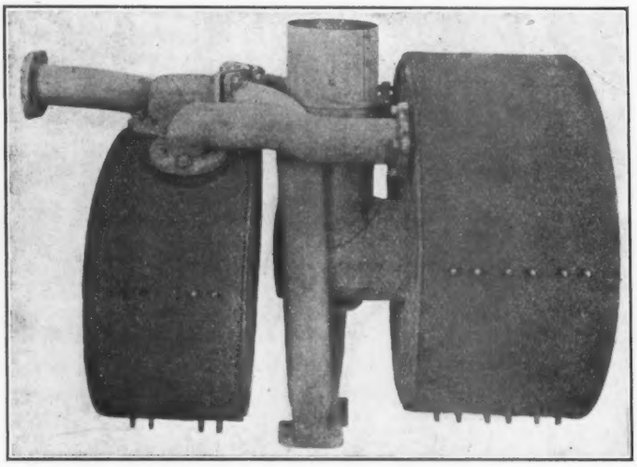
Flue gases pass straight through the tubes of the rear drum from the boiler tubes. Upon leaving the rear drum, the gases are deflected around the petticoat pipe and elbow and pass forward through the tubes of the forward drum to the front end of the smoke arch. Here they are reversed and drawn backward through the cylindrical opening in the forward drum and are swept upward through the petticoat pipe to the stack.

To aid in the direction of the greater portion of the gases through the flues of the superheater drums a deflecting plate is so located as to obstruct the rapid flow of gases around the drums. The shape of this plate conforms to the area between the forward drum and the smoke arch and the plate is located about one inch ahead of the forward drum. A wide opening at the bottom of the plate allows a rapid flow of gases through this section to sweep out any cinders that might fall to the bot-

tom of the smoke arch. The shells of the drums are thus allowed to come in contact with hot gases, but the gases around these surfaces have little or no velocity.

The passage of gases through the tubes of the superheater drums so breaks up the cinders carried by the gases that the usual form of front end netting is unnecessary. The arrangement incident to the application of this type of superheater is a radical departure in the drafting of American locomotives, as it does away with the diaphragm and netting, the draft being very direct and also pulling on the fire much more evenly, thus obtaining more complete combustion and more efficient evaporation.

Steam is conducted from the dry pipe to the forward drum,



JACOBS' SUPERHEATER FOR SIMPLE LOCOMOTIVE.

where it is circulated around the tubes. When the superheater is applied to a simple engine, the steam is conducted from the forward to the rear drum, where it is again circulated around the hot tubes, and it is then carried to the steam chests. Baffle plates of thin sheet iron direct the circulation of steam in both drums.

When applied to a compound engine, steam is conducted from the forward drum to the high pressure cylinders. Exhaust from the high pressure cylinders is directed to the rear drum where the steam is again superheated before being passed on to the low pressure cylinders. The accompanying line engraving illustrates the superheater and its connections applied to the balanced compound locomotives of the Atlantic type described above.

It is reported that the first Jacobs' superheater placed in service has been in continuous operation for 13 months with absolutely no repairs to the superheater. One hundred and forty-six superheaters of this type are now in operation and under construction. The average superheat obtained is 90 degrees and a saving of 12 per cent. in fuel and 25 per cent. in water is said to have been attained.

This superheater was designed by H. W. Jacobs, assistant superintendent of motive power of the Santa Fe.

Buck Superheater.

The locomotives of the Mallet type are equipped with a superheater consisting of a single drum. This superheater operates on the same principle as the two-drum superheater, being divided into two sections by an intermediate head. The tubes are 76 inches long and the intermediate head is 54 inches from the front head. The superheater is located in the combustion chamber and is shown in one of the illustrations.

Steam from the dome is carried to a connection at the top of the forward section and emerges through two steam pipes connected at the bottom, by which it is conveyed to the high pressure steam chests. Exhaust from the high pressure cylinder is brought together in one pipe at the center of the engine, by which it is conducted to the bottom of the rear superheater section. These steam pipes are provided with separable joints in order that the front section of the boiler may be removed from the rear section, the superheater being secured in the forward section.

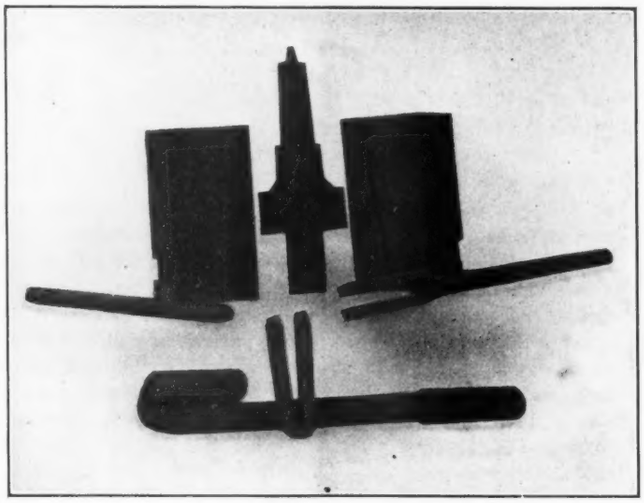
From the rear section of the superheater steam is conducted to the low pressure cylinders through a single pipe located centrally between the frames. This pipe is equipped with a slip joint and two ball joints, one of the ball joints being located immediately beneath the rear section of the superheater and the other just ahead of the second driving axle. Forward of this point the pipe is held in alignment with the frames and a short distance back of the low pressure cylinder it is divided into separate leads in order to convey steam to the two steam chests.

The superheater of the single-drum type was designed by W. F. Buck, superintendent of motive power of the Santa Fe.

FORGING BRAKE ROD JAWS.

There has appeared in these columns a number of articles descriptive of the machine forging methods in use at the Collinwood shops of the Lake Shore & Michigan Southern Railway.* Among the latest developments along this line at that point are dies and formers for forming a brake rod jaw, which it is practically impossible to break at the connection. The accompanying illustrations show the dies as well as the parts before and after forging.

The jaw proper is previously formed in a bulldozer and the bend is heated in a furnace to a welding heat, as is also the end of the shank of round or square bar iron, and the two are forced together by hand on a special anvil and then placed in the forging machine, where a stream of air is kept playing over the point to be welded, keeping it at a very high welding heat. The side dies then come together, holding the bar securely, while the center die comes forward, forcing the jaw on to the shank and upsetting the section at the weld somewhat. The extension on the end of the center die forces a small hole through the jaw into the shank, all of this metal being at a full welding heat, so that the fibers of the iron of the two pieces are interlocked



DIES AND FORMER FOR FORGING BRAKE ROD JAWS.

and securely pressed together, both inside and outside. The work is then removed from the machine and placed over a former, which brings the legs of the jaw parallel and in proper alignment.

For making the lower brake rod, the same operation is gone through on the opposite end of the shank, which is cut to proper length.

* See April, 1906, page 142; June, 1906, page 234; May, 1907, page 192; September, 1907, page 344, and April, 1909, page 131.

Jaws forged in this manner have been put in the testing machine and have also been bent cold, both twisting and in other directions, without being able to separate the parts of the weld. A jaw which has been bent back upon itself at the weld without damage is shown at the bottom of the illustration.

TIMBER DECAY COSTS MILLIONS.

Millions of feet of timber and finished lumber rot every year in railroad ties, bridges, trestles, piles, farm buildings, fences, poles, and mine props. The lumber consuming public of the United States pays perhaps thirty to forty million dollars a year to make good the losses from wood decay. These great drains are a source of more and more concern each year. Chemists and engineers who have to do with the uses of wood are working unceasingly on the problem. The United States Forest Service has men who devote their whole time to it. The importance of the problem can not be overestimated. Millions of dollars are annually saved by preservative treatment of timbers, but much yet remains to be learned.

Wood decay is caused by fungus, a vegetable growth sometimes so small that it can be seen only with the microscope. Its roots or branches, like minute hairs, force their way into the wood tissues and absorb or eat away the solid parts. The collapse which results is called decay. Timber is artificially preserved by forcing into its cells and pores certain substances which prevent the growth of fungi. As long as this substance is present in sufficient quantity, the germs of decay—the threads and spores of fungas—can not enter, and the wood is preserved. This often means doubling and sometimes trebling the life of the timber.

The United States government considers the investigations of the preservative treatment of timber of such importance that the business of one office of the United States Forest Service, that of Wood Preservation, with new headquarters at Madison, Wis., is given over entirely to the work of experiments in cooperation with railroad companies and other corporations and individuals in prolonging the life of railroad ties, mine props, bridge timbers, fence posts and transmission poles.

RAILROAD FATALITIES SHOW MARKED DECREASE.

Particularly gratifying are the reports recently issued by several of this country's railroads, showing a large total of passengers carried without a single fatality. The Pennsylvania Railroad, for instance, was perhaps the first to make this favorable report, with a total of 142,676,779 passengers carried in 1908 with not a single fatal accident due to inefficient operation, exclusive of accidents at crossings or result of a passenger's own carelessness in getting on or off of moving trains.

This extremely favorable report has been followed by others showing that the Chicago & North Western carried 25,994,182 passengers in the year ending June 30, 1909, without a single fatal accident, the Rock Island 18,743,022 passengers, Burlington 20,000,000, Atchison 22,605,697, Lehigh 4,877,801, while the Erie reports 125,000,000 passengers carried in the past five years without a fatality.

This aggregates a total of 330,000,000 passengers carried safely and presents a striking example for other roads. And not the least peculiar feature of these reports is the fact that with the exception of the Pennsylvania, Lehigh Valley and Erie, the roads reporting this absence of fatalities are in the West, where a large proportion of single track prevails, use of safety appliances is less general, and the roadbed is in most instances not up to the Eastern standards.—*Railway World.*

MOTOR CARS.—The motor car used by the Santa Fe in southern California has developed so much business that it has been taken off and a regular train put on instead.—*Santa Fe Employe's Magazine.*

VALVE CHAMBER BUSHING PRESS.

The installation and removal of valve chamber bushings on piston valve engines with sufficient pressure to assure them remaining in place is usually accomplished with more or less expenditure of time and effort. For performing this operation there has been designed and constructed at the Collinwood shops of the Lake Shore & Michigan Southern Railroad a hydraulic press which is mounted on wheels, so as to be easily transferred to different parts of the shop, and has a ram conveniently adjustable in all directions, making it easy to apply to the valve chamber of any locomotive in the shop.

It is made up of two heavy upright columns, securely fastened to the body of a cart, on which a crosshead slides. Two long screws are located just inside of the columns, guided top and bottom, and operated by means of beveled gears from one shaft, the squared end of which is seen just below the bottom of the

HYDRAULIC PRESS FOR VALVE CHAMBER BUSHINGS.

cart. These screws are threaded in the crosshead and control its movement. On one side of this crosshead is secured an old hydraulic jack from which the ram has been removed and the top opening plugged. On the opposite side is a heavy arm constructed of boiler plate arranged to swing around its single substantial connection to the crosshead. The outer end of this plate, or arm, carries a hydraulic ram about 3 in. in diameter. This arm with the ram can be swung around its pivot as desired, its location being controlled by two threaded rods with hand wheels so constructed and placed as to securely hold it in any location.

The hydraulic pressure is carried from the chamber, where it is obtained by means of the same pump and handle that was previously used on the jack, to the ram by a heavy copper pipe, which passes through the center of the joint of the arm and is fitted with a swivel joint. A coil on the ram side gives it further flexibility. Pressures of 25 to 30 tons are easily obtainable with this arrangement. Both bushings are put in at once, and removed at once, if desired, by means of the rods and plates shown lying on the cart.

This device has not only proven to be very convenient and rapid, but it also permits the bushing to be put in under a pressure which will assure it remaining in place.